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Economy of Motor Ships

Some interesting figures regarding the relative economy of a steamship and a Diesel motor ship of about the same speeds on long voyages were given recently in a paper read by Mr. I. Knudsen, of Burmeister & Wain, before the Northern Merchants' Shipping meeting at Malmo. The deadweight capacity of the steamship was 8,720 tons, and of the motor ship 9,700 tons. The average speed of the vessels was in the neighborhood of 11 knots. Considering the item of fuel only, the relative costs of carrying 1,000 tons of cargo a distance of one mile at 11 knots on the steamship and on the motor ship showed a saving equivalent to 67 percent in favor of the motor ship. Other factors which might have an important bearing on the relative costs of operation, however, were not taken up in detail.

United States Coast Guard

It is gratifying to note the favorable action taken by both Houses of Congress on the bill creating a Coast Guard by combining the existing Life Saving and Revenue Cutter Services. Years ago both of these services were administered under one executive head, but lately, although both are devoted mainly to the saving of life and property from the ravages of the sea, they have been operated as distinct organizations. By combining the two, it is confidently expected that the efficiency of the Life Saving Service will be materially increased and a Naval Reserve of about 4,100 trained and highly efficient officers and men will be created which will be ready at a moment's notice to operate under the Navy Department whenever the President so directs. A retired list is provided for the men on account of age, or after thirty years' service, and the men of the Life Saving Service will receive longevity pay for re-enlistments. They will also have clothing allowances and medical attention from the Public Health Service. In lieu of a pension list for the dependents of those who lost their lives in the service, a sum of money equivalent to two years' pay is given. This measure does not in any way increase the number of employees of the government, neither does it raise the basic salaries of the men already employed, as all increases in pay are due to length of service only; nor does any commissioned officer of the Revenue Cutter Service receive an increase in pay or allowances on account of this change. It is very evident that this measure will be advantageous both to the government and to the men employed in these branches of the military forces of the government, and it is gratifying to know that all of this will be brought about at a maximum total increased cost of less than 8 percent of the present annual cost for the entire maintenance and operation of the two existing services.

Future French Battleships

Since the beginning of the war little has been said regarding the new battleships that the French Admiralty intended to build as soon as the vessels of the *Normandie* class were launched. The four battleships proposed were to be named the *Duquesne, Trouville, Lyon* and *Lille,* but, on account of the uncertainty of the war, it is quite impossible to state when these vessels will be laid down, or what changes may be made in their design. In spite of this, however, it is interesting to examine the main features of these vessels as originally proposed. The new battleships were to have a length of 624 feet and a normal displacement of 29,500 tons, as compared with the length of 574 feet and the displacement of 25,300 tons of the vessels of the *Normandie* class. The beam in both cases was the same, 88 feet 7 inches, although the draft at the stern of the new vessels was to have been 29 feet 10 inches as against 29 feet in the previous class. The new battleships were designed for a speed of 23 knots, for which it was estimated a brake horsepower of 42,000 would be required as against 32,000 brake horsepower in the older ships, which have a speed of only 21 knots. The armament of the *Duquesne* was to consist of sixteen 13-inch guns arranged in four 4-gun turrets of the same type as on the *Normandie*, although the probable arrangement of the turrets would be in accordance with the arrangement on the United States battleship *Michigan,* with a possibility, however, that turret No. 3 would be placed amidships, as on the *Normandie.* The 13-inch guns were to be of an improved design which is claimed to be as powerful as the 14-inch guns used by other naval powers. The turrets were to be hydraulically operated with the Janney patent gear. The secondary battery was to consist of twenty-four 5.5-inch guns, also of an improved

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design superior to the rapid fire guns on the *Normandie*. In general, the armor on the new vessels was to have been of greater thickness than the armor on the *Normandie*, which was 14.5 inches thick at the waterline. The whole protection of the *Duquesne* was to have been more extensive than on the *Normandie*. The propelling machinery was to be of the combination type, arranged on four shafts with the high-pressure reciprocating engines on the center shafts and low-pressure turbines on the wing shafts. This arrangement has been widely adopted on large French liners, and is in general considered to be the most efficient arrangement of machinery that could be adopted for this type of vessel. Although the above designs are wholly tentative and may be considerably modified, if the ships are finally laid down, they are nevertheless of considerable interest in view of the latest battleship designs developed for the other naval powers.

Surprising Failure of Steel Ship Plates

Considering the treatment which ship plates must undergo, both in the shipyard while being flanged and riveted, and afterwards in the ship in service when the plates are subjected to unknown stresses, the necessity for a method of testing the steel of which the plates are made to determine its suitability for the purpose is of the utmost importance. Lloyd's Rules for testing shipbuilding materials are generally regarded as reliable, and steel which is passed by Lloyd's surveyors is generally accepted as suitable for the purposes intended without further investigation. A case is cited, however, by Mr. W. J. B. Wilson in a paper recently read before the North East Coast Institution of Engineers and Shipbuilders, in which a consignment of steel ship plates, after passing Lloyd's tests and being characterized by the surveyor as "excellent," failed in a surprising manner shortly after being worked into the ship.

In this case the shipbuilding firm received an order for an ice-breaking passenger and cargo steamer to be built to Lloyd's highest class under special survey. The vessel was begun in November, 1907, but, owing to delay in obtaining the material, the shell plating was not begun until the end of December. B strake was first worked, but, owing to the difficulty with the flanging of the garboard strake plates, several of which cracked, the rest of the shell was practically completed before the garboard strakes were put in place.

The garboard strake plates which cracked were carefully examined, but as the results of both bending and tensile tests were excellent, the failure at the time was ascribed to the severe cold weather prevailing, the temperature being from —13 to —18.4 degrees Fahrenheit.

The riveting of the shell was well under way before the keel riveting was begun, but, after a few garboard plates had been riveted, cracks were noticed between the rivets and the edge of the plate in the flanged portion. These plates were condemned by the Lloyd's surveyors and were cut out. During the process two of them cracked badly in the neighborhood of the keel rivets, and the astonishing fact developed that a single blow with an ordinary hand hammer was sufficient to knock pieces out of the flanged portion.

This sudden change in these plates, which had withstood flanging, punching, riveting, and, in some cases, calking, was very remarkable and the job of riveting the keel was at once stopped until a thorough hammer test of the flanged portion of all the remaining garboard plates had been made. When this proved perfectly satisfactory, the riveting was resumed and only one or two small cracks developed.

About this time severe cold weather set in again, and on January 11, 1908, one of the garboard plates, which had been riveted in the ship for a period of three weeks, was found to be badly cracked. The crack started from a rivet hole in the flanged portion and went off into the plate in a transverse direction, being about 10 inches long and about 3/32 inch open at the widest part. This was clearly a case of spontaneous rupture.

When this plate was cut out the material in way of the keel rivets cracked in the same way as that described above, and a new hammer test was made with startlingly different results from the previous one, as every plate in the garboard strakes, with the exception of those previously replaced, cracked and in some cases pieces fell out. These plates were, therefore, condemned and cut out.

So far the cracks had been entirely confined to the flanged portion of the garboard strakes, but during the cutting out of the rivets connecting the garboard plates to B strake several plates in B strake also cracked. A new survey was then made by Lloyd's and pieces cut from the plates in the ship rolled from different charges were tested. All of the tests proved satisfactory to the surveyor, but after these tests the astonishing fact developed that one blow of a heavy hammer was sufficient to knock large pieces out of flanged portions of the shell plates. The net result of this survey was that all plates rolled from the same charge as the garboard strakes, together with several plates which had bad surface defects, were condemned. The latter had been filled with some composition which fell away during riveting. One plate had two large holes which had been filled up. A 6-inch feeler pushed into these holes penetrated 1½ inches, while the makers' brand was not 12 inches away on the same side of the plate.

The condemned plates, twelve in number, were in various strakes of the shell plating, and during the removal, in spite of the care taken, the trouble spread over the whole of the bottom of the vessel. As an example, one of the plates in E strake, ½ inch thick, which had been punched, sheared, bent, riveted and calked without any trouble, had to have the rivets in its lower edge removed in order to take out a plate in D strake. When the rivets were center-punched preparatory to drilling them out, the plate in E strake cracked, although it was not actually touched by the hammer, which was only an ordinary hand

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hammer. In the edge of this plate, when all the rivets had been drilled out and driven, sixteen cracks were found.

This plate was afterwards examined by Lloyd's surveyors, when it was plainly shown that one blow with a sledge hammer was sufficient to cause cracks to appear between the edge and butt rivet holes; but, although the hammering was continued, not a single crack would travel far into the plate away from the rivet holes. The failure still continuing, a new survey was made by two of Lloyd's surveyors, one of whom had previously tested the steel. Tests were made, but these, like all the others, failed to throw the slightest light on what was really wrong with the steel. The treatment of the steel was criticised, but it was subsequently established that the workmanship in the shipyard was above reproach.

After these tests had been made, the surveyors maintained that as the steel passed the tests laid down in the rules, they were not justified in blaming the material unless a test could be devised which would in their presence prove the steel to be at fault. Meanwhile, the author of the paper, who had made scores of tests with this object in view, had found one that gave the required results, and which may prove useful to others in like circumstances.

This test consisted of placing a butt strap which had not been worked into the vessel and a plate of material made in a Swedish steel works in a mixture of snow and salt, which reduced the temperature of the plates to —4 degrees Fahrenheit. The plates were then quickly punched on one side for double riveting and riveted together, care being taken that the edges of the plates opposite the holes were kept cool with ice in order to represent as closely as possible the conditions when working the steel in a low temperature. After the plates were allowed to cool down, the rivets were driven out, during which operation the plate from the butt strap cracked badly and a piece fell out. The plate from the Swedish steel works, however, did not show the least signs of cracks.

From another plate two strips 2⅜ inches wide were cut and four holes ⅝-inch diameter and 4½ diameters apart were punched and the strips riveted together. The same was done with two similar strips, but with drilled holes, the temperature at the time being about 39.2 degrees Fahrenheit. After cooling, the strips were bent through an angle of 25 degrees and the outer strip was found to be broken right through in the punched sample and cracks were found in the drilled sample.

These butt strap tests were sufficient to convince all concerned that the material was really entirely spoiled by riveting, and therefore the builders were relieved from all blame, the workmanship being characterized as "first class." A further proof that the material was bad was the very conclusive one of the new Swedish material, which, although worked in the same way, gave no trouble at all.

From the foregoing, it is evident that the ordinary methods of testing in this particular case were insufficient to detect the poor quality of the material which was being used, and dependence upon such tests under like conditions certainly seems to place shipbuilders and others in a position in which they run grave risks. The test made by Mr. Wilson in which a mixture of snow and salt was used certainly detected the fault in this particular steel, and is therefore worthy of consideration. Subsequent tests of samples of this steel made by Professor J. O. Arnold of the University of Sheffield, showed that from a chemical point of view the steel was not of very good quality, and that it appeared to have been overheated in the manufacture and gravely injured by the operation.

Electricity on Board Ship

Light, heat and power are the three main classifications under which electricity is used on board ship, but in no type of vessel is electricity put to more varied uses than on a modern battleship. On the Argentine superdreadnought *Moreno,* for instance, which is of 27,566 tons displacement, the electrical generating plant consists of four 375-kilowatt turbo generators of the horizontal type, while in addition there are two Diesel oil engine-driven generators of 75-kilowatt capacity each, for harbor use when the fires are drawn. The electrical equipment on this vessel is the largest and most costly ever installed in the United States, and comprises 3,000 electric lights, 4,000 rated horsepower of motors and approximately 76 miles of cable. Several other features aside from the size of the plant are noteworthy in that a voltage of 230 is used, which is a departure from ordinary American marine practice. These features include the employment of lead-covered steel armored conductors, the application of 220-volt Tungsten lamps, the use of electricity for steering the vessel, operating the anchors and bilge pumps, for turret turning, gun elevating and many other purposes, so that the equipment stands as a valuable working comparison with previous installations.

On the large transatlantic liners, the application of electricity is no less striking; for instance, on the *Aquitania,* where the generating plant consists of four 400-kilowatt, 225-volt continuous current turbo generators, there is a total of 200 motors aggregating 2,590 horsepower, in addition to nearly 10,000 lamps supplied with current at 110 volts. Similarly on the *Mauretania,* independent of the power for lighting, there is a total of 2,133 horsepower of motors; all of which goes to show the rapidly increased application of electricity on board ship. In considering the question of lighting on board ship, where savings of space and weight are of much importance, the use of Tungsten lamps offers several distinct advantages. Tungsten filament lamps consume approximately 1.10 watts per candle-power as against 3.10 to 3.50 watts by carbon filament lamps, which, reduced to a practical basis, means that by using Tungsten lamps smaller and lighter generating apparatus, lighter wiring and less coal storage space are necessary on the ship.

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Self-Unloading Freight Steamer Huron

Unusual Type of Lake Freighter Fitted with Discharge Boom and Conveyors for Unloading Bulk Freight—Trial Data

One of the most interesting vessels built on the Great Lakes last year was the self-unloading bulk freight carrier *Huron,* constructed at the Great Lakes Engineering Works, Detroit, Mich., for the Wyandotte Transportation Company, Wyandotte, Mich. The vessel was launched February 7, 1914, and completed April 22, 1914. Its length over all is 439 feet 3 inches and on keel 416 feet. The molded beam is 56 feet and the molded depth 30 feet.

The general arrangement of the vessel is similar to practically all bulk freighters, the machinery being aft and the pilot house and "texas" forward on the forecastle deck, with the quarters for officers and crew in the deckhouse aft and in the forecastle and "texas" forward. There are in all 21 hatches and the net cargo capacity at 19 feet draft is 8,000 tons of stone and on about 16 feet draft 6,000 tons of coal. The water ballast capacity is 5,200 tons, and the machinery installed is designed to give the vessel a speed of 12 miles per hour.

The cargo space is arranged in two long hoppers running practically the full length of the hold, the slope of the hoppers being about 35 degrees. The water bottom is 3 feet 6 inches deep for a width of 31 feet. On each side of this the side tanks are carried up to the slope of the hopper. Along the centerline of each of the fore-and-aft hoppers are 32 gates, spaced generally 7½ feet between centers. These gates are of the hinged type and each one is operated by a large hand wheel with shaft and chains, as shown in Figs. 8 and 9.

Directly under the center of each of the hoppers and just above the water bottom is a 42-inch pan conveyor running the full length of the hold, and rising at the forward end to discharge into a cross chute, which delivers the cargo from both the fore-and-aft conveyors to a 72-inch pan conveyor on the centerline. This centerline conveyor carries the stone up above the spar deck and discharges onto a 48-inch belt conveyor, which delivers the stone over either side of the ship.

This belt conveyor has a length of 100 feet between centers and is carried on a truss, which is divided at the forward end and arranged so that it can be lifted to an angle of 20 degrees and swung outboard to an angle of 90 degrees with the ship on either side. The maximum reach of the discharge conveyor is 67 feet from the side

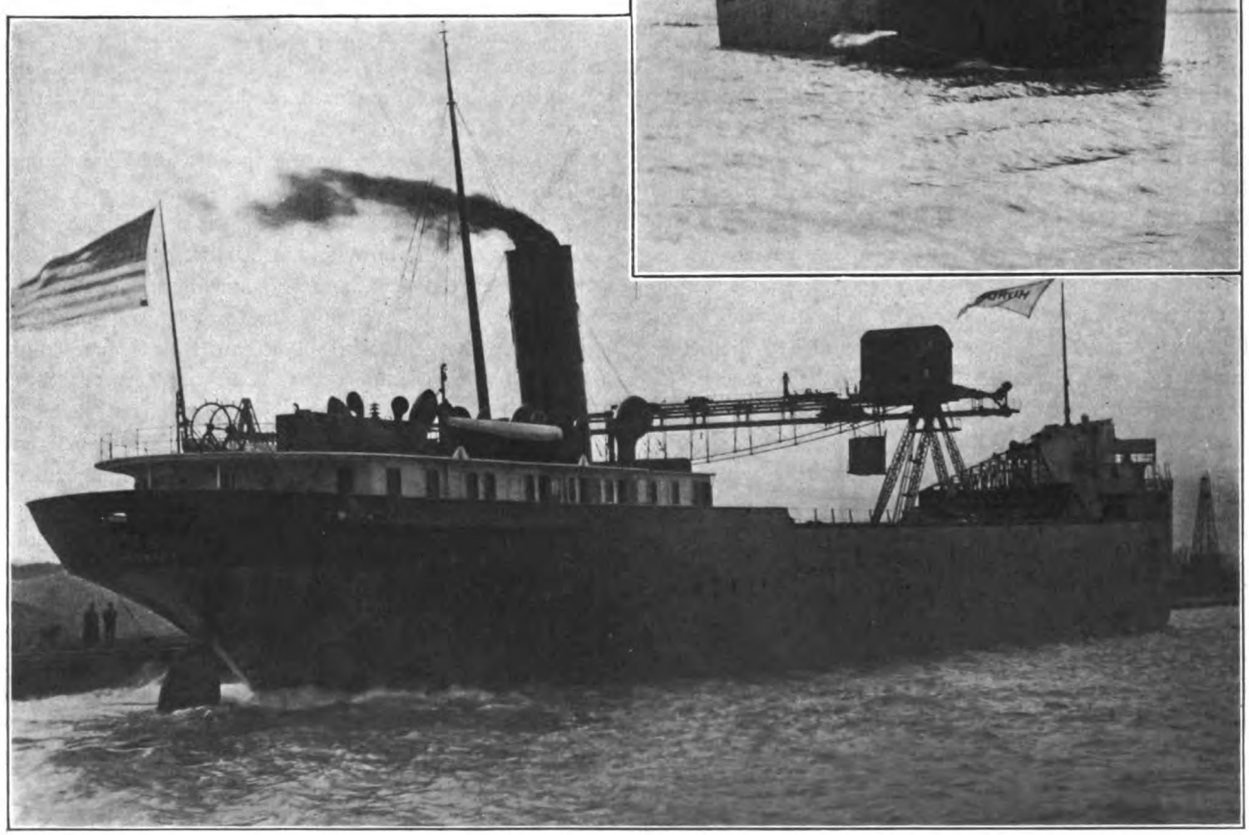

Fig. 1.—*S. S. Huron* at the Michigan Alkali Company's Dock

Fig. 2.—Bow View of the Vessel

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of the ship and 52½ feet above the waterline, but, by the use of a short steel chute at the upper end of the boom, the stone can be thrown several feet farther from the ship than the actual reach of the belt.

CONVEYING MACHINERY

The conveyors are driven by two 150-horsepower reciprocating steam engines located on the spar deck in the forecastle. Ordinarily, one of these engines drives the two horizontal conveyors, while the other one drives the central inclined conveyor and the belt conveyor in the discharge boom. This same engine also drives the drum which raises and lowers the boom. The two engines are arranged with a connecting belt and clutches, so that in case of necessity either engine can be used to drive any part of the machinery.

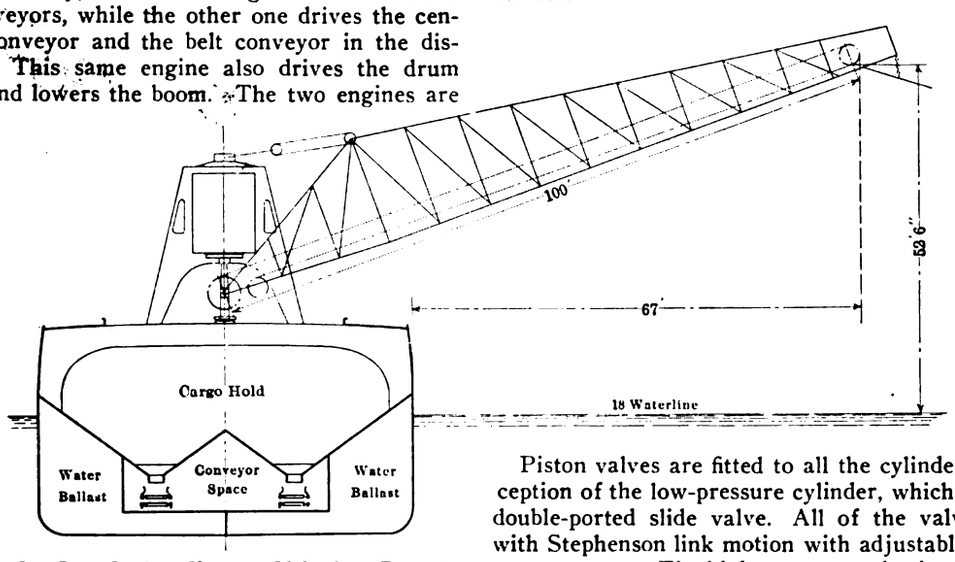

Fig. 3.—Cross-Section Showing Unloading Boom in Outboard Position

The conveying machinery is all controlled by levers on the spar deck, just aft of the forecastle, so that the operator has a full view of the discharge boom and therefore has complete control of its movements.

PROPELLING MACHINERY

The main engine of the *Huron*, as stated before, is located aft. It is a vertical quadruple expansion engine with cylinders 19½ inches, 28¼ inches, 41 inches and 60 inches diameter with a common stroke of 42 inches. The designed indicated horsepower at 85 revolutions per minute and 35 pounds mean effective pressure is 1,770, while the maximum horsepower will run well over 2,000 with an increase in the revolutions to approximately 93 per minute. The usual arrangement of cylinders has been followed in this engine, and the sequence from forward to aft is high-pressure, low-pressure, second intermediate-pressure and first intermediate-pressure. The crank sequence is high-pressure, first intermediate, low-pressure and second intermediate-pressure. The question of balance of moving parts has been given very careful attention, with results which have proved highly satisfactory in service.

Piston valves are fitted to all the cylinders with the exception of the low-pressure cylinder, which is fitted with a double-ported slide valve. All of the valves are driven with Stephenson link motion with adjustable cutoff on the reverse arms. The high-pressure valve is 13 inches diameter; the first intermediate, 16 inches diameter, and the second intermediate, 21 inches diameter. All of these piston valves have a travel of 5½ inches. The low-pressure double-ported slide valve has ports 49 inches wide, while the travel is 7 inches.

All of the pistons are of cast-iron box section, the high-pressure having a removable solid follower ring with water grooves. The first and second intermediate pistons have removable follower plates and adjustable bull rings to allow for wear, while the low-pressure piston has packing rings with spring adjustment. In order to facilitate the balancing of the engine, the high-pressure and second intermediate pistons are heavy castings.

The piston rods are of open-hearth steel 4⅞ inches diameter in body, secured to the pistons with a taper fit and a 3¾-inch nut and to the crossheads with a taper key. The crossheads are of cast steel fitted with removable brass shoes on both ahead and astern faces; the crosshead pins are machine steel 5¾ inches diameter and 7¾ inches

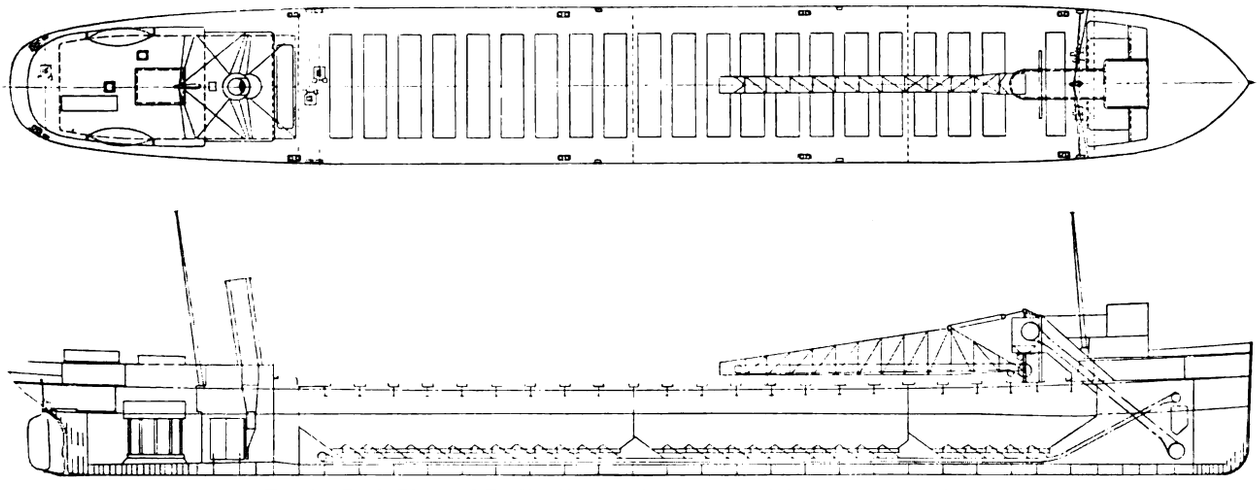

Fig. 4.—Deck Plan and Profile, Showing Arrangement of Conveyors on the *Huron*

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long taper fitted to the crossheads for each piston rod.

The connecting rods are of open-hearth steel 8 feet 6 inches in length, center to center, with brass top end boxes adjustable for wear by means of a block and fore-and-aft taper wedge. The crank-pin boxes are of cast steel Babbitt-lined and are secured to the T ends of the connecting rods with annealed steel bolts 2½ inches diameter in the body and 2¾-inch thread. The body of the connecting rod is 4¾ inches diameter at the top and 5¾ inches at the bottom.

The crank shaft is of open-hearth steel of the built-up type with cast steel slabs securely shrunk and pinned to the shaft. Near the center a coupling is fitted with one-half forged on the after section and the other half formed in the cast-steel crank slab. The forward high-pressure and after first intermediate slabs have balance weights cast with the crank slabs. The diameter of the crank shaft and of the crank pins is 12 inches and the length of the crank pins 11 inches. The shaft is supported in five journals, three of which are 18 inches long, and two 14 inches long, all lined with Babbitt and having semi-steel caps secured with binder bolts 3¼ inches diameter.

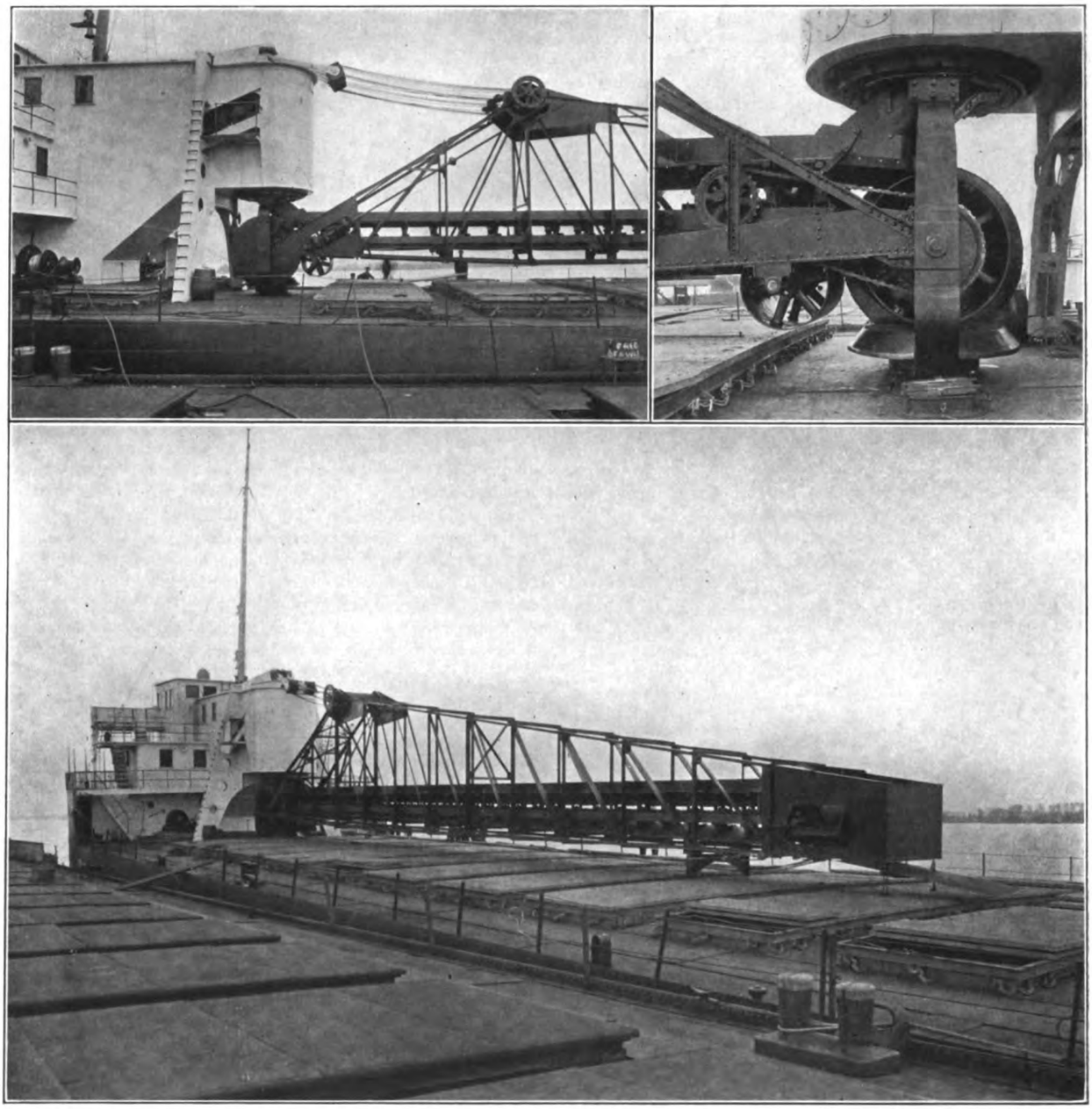

Fig. 5.—Upper End of Casing of Central Conveyor and Inboard End of Discharge Boom, Showing Method of Pivoting Discharge Boom and Blocking and Tackles for Elevating Boom

Fig. 6.—Inboard End of Discharge Belt and Boom, Showing Large Forging on Which Boom is Pivoted

Fig. 7.—View of Deck, Showing Discharge Boom and Forward House

The thrust shaft is also of open-hearth steel 12 inches diameter with the thrust collars forged on. The tail shaft is of the same material 12½ inches diameter in the body and 13¾ inches in the bearing, which is 4 feet 6 inches long fitted with lignum vita and Babbitt strips. The thrust block of cast iron has cast iron shoes faced with Babbitt on both faces and adjustable for wear. There are five collars, making the unit thrust pressure about 47 pounds per square inch.

The bedplate and both the front and guide columns of

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Fig. 8.—View on Tank Top under Hoppers Looking Forward, Showing After End of Starboard Conveyor

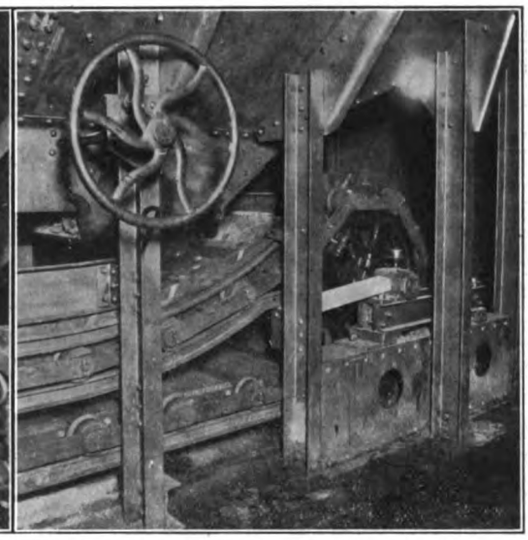

Fig. 9.—After End of Starboard Conveyor, Showing One of the Gates and Hand Wheel that Operates It

the engine are of cast iron of box section, all securely bolted at their various points of connection. Reversing of the engine is accomplished with a direct-acting steam cylinder 10 inches bore and 24 inches stroke, and provision is made for both reversing and turning the engine by hand.

The propeller is of the sectional type with four blades. Both the hub and blades are of cast iron with machine-steel stubs and brass ends. The diameter of the propeller is 14 feet 6 inches; the pitch, 13 feet 3 inches at the tip and 12 feet 1 inch at the hub, with a total developed area of 75 square feet.

Boilers

Steam is supplied at a pressure of 215 pounds per square inch by two Scotch boilers, 14 feet 9 inches mean diameter and 12 feet long over all. Each boiler has three corrugated furnaces, 44 inches inside diameter, leading to separate combustion chambers. The total heating surface in the two boilers is 5,192 square feet and the total grate surface 110 square feet, making a ratio of heating surface to grate area of 47 to 1. The heating surface in each boiler is divided as follows:

Tubes	2,211 square feet
Furnaces	140 square feet
Combustion chambers	245 square feet
Total	2,596 square feet

The draft area through the tubes is 13.28 square feet, making a ratio of grate surface to draft area of 4.14 to 1.

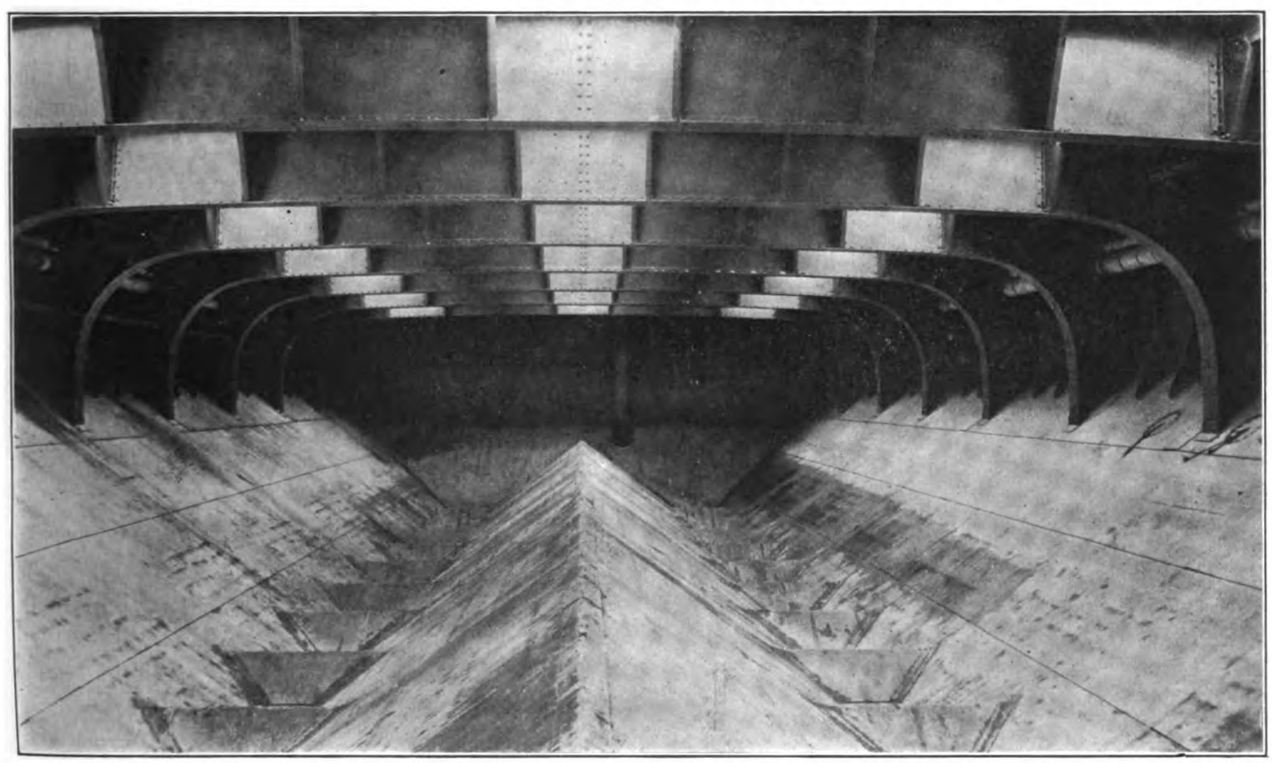

Fig. 10.—Inside of No. 3 Hold Looking Aft, Showing Fore-And-Aft Hoppers and Also Small Cross Hoppers

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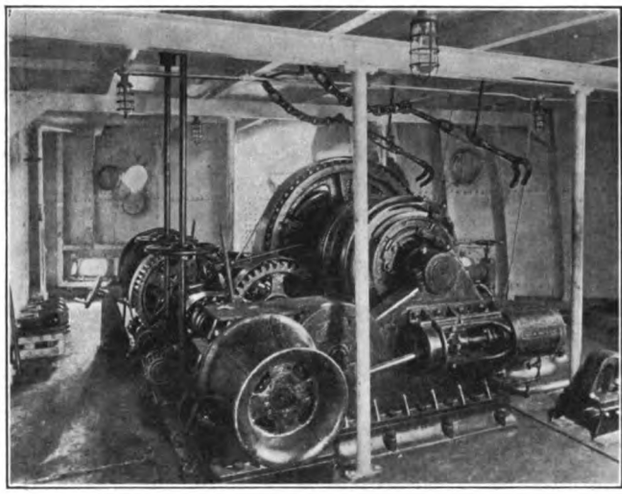

Fig. 11.—Windlass and Windlass Room

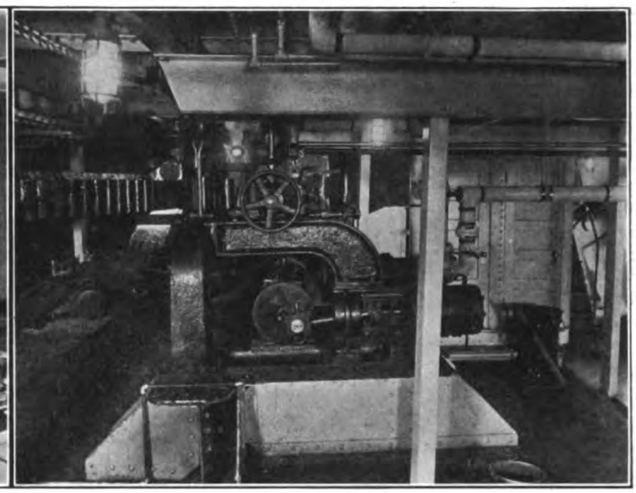

Fig. 12.—Steering Engine and Part of Quadrant

The boilers work under a system of positive heated draft, the air being conducted to the furnaces through a system of ducts.

The main steam stop valves are 6 inches diameter, and the main steam pipe 7 inches diameter. The auxiliary stop valves are each 5 inches diameter, supplying steam for all purposes, including also the unloading machinery forward.

The safety valves are 5 inches diameter, the feed valves 2 inches diameter, the main feed valves from the purifiers are 4½ inches, the main blow-off 2½ inches and the surface blow-off 1½ inches in diameter, respectively.

AUXILIARIES

All of the pumps in this vessel are independent of the main engine with the exception of the air, bilge and water-service pumps. The attached air pump is of the double-acting type driven from the low-pressure crosshead with a beam and connections. It is 24 inches diameter with a

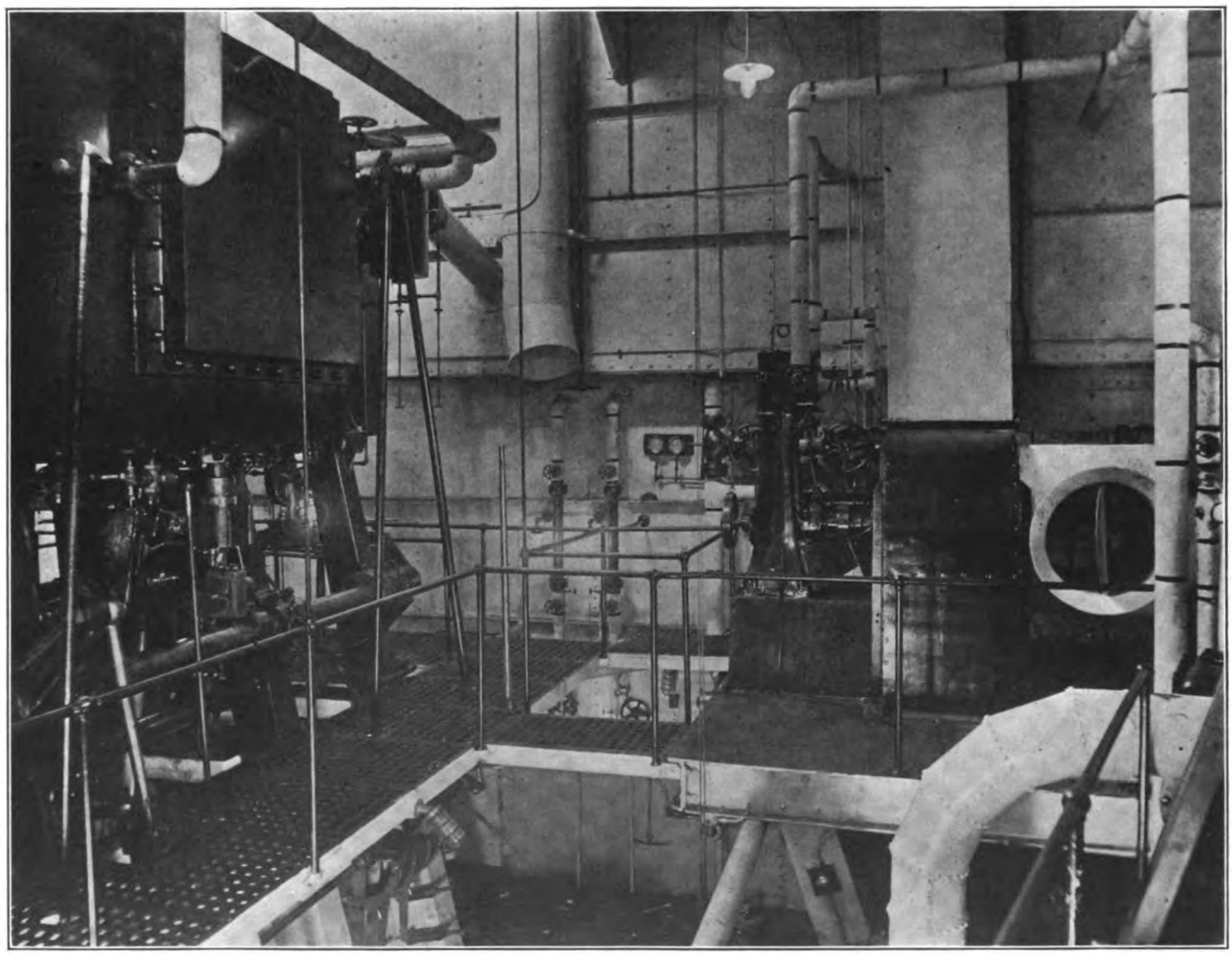

Fig. 13.—Starboard Side of Engine Room, Looking Forward at the Level of the Upper Grating

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stroke of 14 inches. The bilge pump, driven from the same beam, is single-acting, 5 inches diameter and 12 inches stroke, while the water-service pump is also single-acting, 3½ inches diameter and 12 inches stroke.

The other pumps include a main feed pump 12 inches by 7 inches by 12 inches simplex double-acting; auxiliary feed and general service pump 10 inches by 6 inches by 10 inches duplex double-acting; one mate's pump 6 inches by 4 inches by 6 inches duplex double-acting; one sanitary pump 4 inches by 2¾ inches by 4 inches duplex double-acting; one 12-inch centrifugal ballast pump, and two 12 inches by 16 inches by 18 inches duplex double-acting ballast pumps.

For handling the exhaust steam from the unloading machinery, an auxiliary jet condenser is installed, together with a horizontal simplex air pump 8 inches by 12 inches by 12 inches.

For supplying air for the heated forced-draft system a fan is fitted driven direct by a single-cylinder 6-inch by 6-inch engine.

One horizontal tubular feed water heater takes care of the boiler feed at all times and two vertical purifiers 42 inches diameter by 8 feet long are installed for the purification of feed water.

Current for all electrical requirements is supplied by two 15-kilowatt generators direct-driven by 7-inch by 7-inch single engines.

TRIAL TRIP

On July 2, 1914, a trial trip of the *Huron* was made between Sanilac and Sturgen Point, the draft of the vessel at the time being 18 feet 6 inches forward and 19 feet 6 inches aft. The vessel was loaded with 4,660 net tons, including fuel. The test lasted from 5:37 P. M. to 11:37 P. M.; the coal was weighed from 5:30 P. M. to 11:33 P. M., and indicator cards were taken every hour. The following table gives the average data taken on this run:

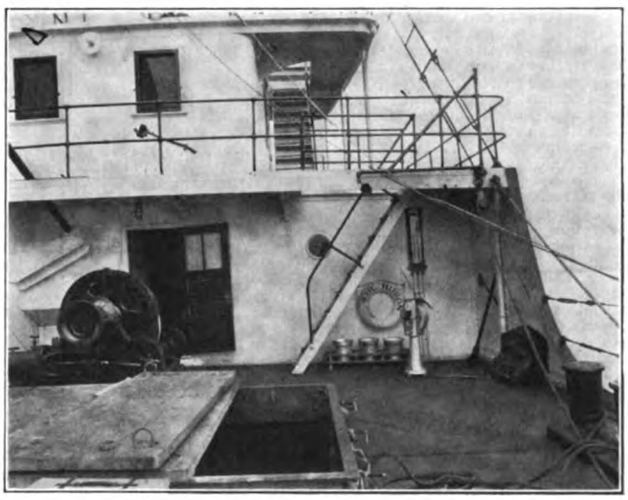

Fig. 15.—View of Deck Looking Forward, Showing After End of Forecastle and Texas on Starboard Side. McNab Draft Gage, with Deep-Sounding Machine just Below It, Can be Seen Directly under the Stairs to the Forecastle Deck

TABLE OF TRIAL DATA

Boiler pressure, pounds per square inch	208
First intermediate receiver pressure, pounds per square inch	86.4
Second intermediate receiver pressure, pounds per square inch	37.5
Low-pressure receiver pressure, pounds per square inch	9.1
Vacuum, inches of mercury	21.2
Revolutions per minute, average	84.9
Piston speed, feet per minute	594.3
Mean effective pressure, high-pressure cylinder	81.7
Mean effective pressure, first intermediate-pressure cylinder	36.
Mean effective pressure, second intermediate-pressure cylinder	14.97
Mean effective pressure, low-pressure cylinder	10.38
Mean effective pressure, referred to low-pressure cylinder	34.
Indicated horsepower, high-pressure cylinder	440.
Indicated horsepower, first intermediate-pressure cylinder	406.
Indicated horsepower, second intermediate-pressure cylinder	356.
Indicated horsepower, low-pressure cylinder	529.
Total indicated horsepower	1,731.
Generator horsepower equal 23 at main engine water consumption.	
Total horsepower plus generator allowance	1,754.
Ratio indicated horsepower to grate area	16.
Ratio heating surface to indicated horsepower	2.9
Temperature of injection water, deg. F	56.

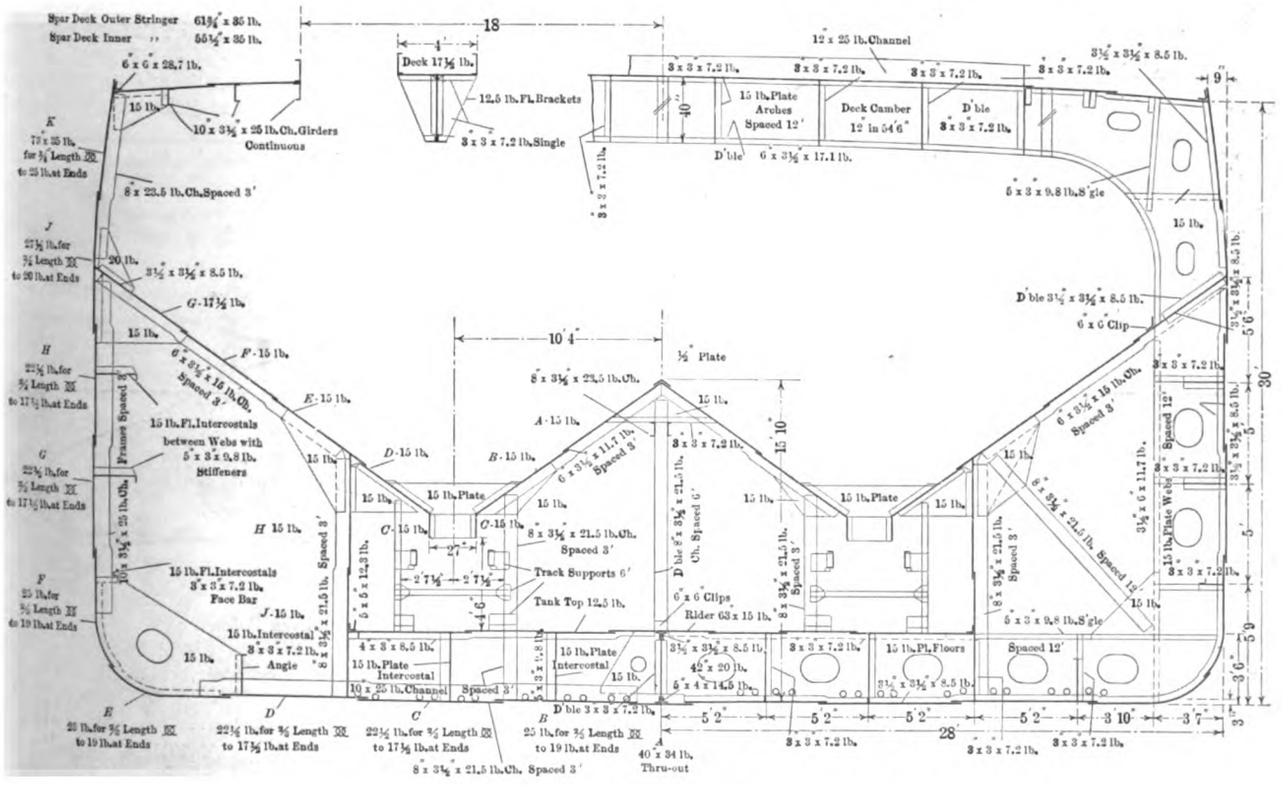
Spar Deck Outer Stringer 61¾" x 35 lb.
Spar Deck Inner " 55½" x 35 lb.
6" x 6" x 28.7 lb.
15 lb.
10" x 3½" x 25 lb. Ch. Girders Continuous
8" x 23.5 lb. Ch. Spaced 3'
20 lb.
3½" x 3½" x 8.5 lb.
G-17½ lb.
15 lb.
6" x 3½" x 15 lb. Ch. Spaced 3'
F-15 lb.
E-15 lb.
15 lb. Fl. Intercostals between Webs with 5" x 3" x 9.8 lb. Stiffeners
D-15 lb.
B-15 lb.
A-15 lb.
C-15 lb.
H 15 lb.
15 lb. Fl. Intercostals 3" x 3" x 7.2 lb. Face Bar
J-15 lb.
15 lb. Intercostal 3" x 3" x 7.2 lb. Angle
15 lb.
Deck 17½ lb.
12.5 lb. Fl. Brackets
3" x 3" x 7.2 lb. Single
18
4'
10' 4"
12" x 25 lb. Channel
3" x 3" x 7.2 lb.
3½" x 3½" x 8.5 lb.
15 lb. Plate Arches Spaced 12'
Deck Camber 12" in 54'6"
D'ble 3" x 3" x 7.2 lb.
D'ble 6" x 3½" x 17.1 lb.
5" x 3" x 9.8 lb. S'gle
D'ble 3½" x 3½" x 8.5 lb.
6" x 6" Clip
½" Plate
8" x 3½" x 23.5 lb. Ch.
6" x 3½" x 11.7 lb. Spaced 3'
15 lb. Plate
8" x 3½" x 21.5 lb. Ch. Spaced 3'
Track Supports 6'
Tank Top 12.5 lb.
6" x 6" Clips
Rider 63 x 15 lb.
4" x 3" x 8.5 lb.
10" x 35 lb. Channel Spaced 3'
15 lb. Plate Intercostal
42" x 20 lb.
5" x 4" x 14.5 lb.
15 lb. Fl. Floors Spaced 12'
3½" x 3½" x 8.5 lb.
40" x 34 lb. Thru-out
8" x 3½" x 21.5 lb. Ch. Spaced 3'
5' 2"
28'
3' 10"
3' 7"
30'
5' 6"
5'
5' 9"
3' 6"
E 25 lb. for ½ Length to 19 lb. at Ends
D 22½ lb. for ½ Length to 17½ lb. at Ends
C 22½ lb. for ½ Length to 17½ lb. at Ends
B 25 lb. for ½ Length to 19 lb. at Ends
A

Fig. 14.—Midship Section

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Temperature of stack, deg. F.	425.
Temperature of air casing, deg. F.	235.
Temperature of ash pit, deg. F.	250.
Temperature of fan intake, deg. F.	76.
Temperature of hot well, deg. F.	129.
Temperature of feed water, deg. F.	178.
Draft at fan, inches of water	1.57
Draft at air casing, inches of water	.7
Draft at ash pit, inches of water	.55
Revolutions of fan	463.
Kind of coal	Fair, ½-lump
Coal consumption, total 6 hours 3 minutes (as fired), pounds	16,050.
Coal consumption per hour (as fired), pounds	2,652.
Coal consumption per hour per I. H. P. (as fired), pounds	1.51
Reduction for British thermal units, percent	7.97
Reduction for moisture in coal, percent	8.37
Unburned coal in ash (6 hours 3 minutes), pounds	777.
Actual coal total (6 hours 3 minutes), pounds	12,643.
Actual coal per hour, pounds	2,090.
Actual coal per hour per I. H. P., pounds	1.19
Actual coal per hour per square foot grate, pounds	19.
Ash, total (as weighed), pounds	2,482.
Ash, total (actual), pounds	1,705.
Ash, percent (as fired)	15.4
Speed of ship, miles per hour	11.89
Distance, Port Sanilac to Sturgen Point, miles	98½
Time of run	8 hours 17 minutes
Slip of propeller, percent	4.
Admiralty coefficient	304.
Weather	fair, light head wind

SHIPBUILDING IN THE UNITED KINGDOM IN 1914.—According to figures published in *Engineering*, the total number of merchant ships launched in the United Kingdom in 1914 was 1,129, making up a gross tonnage of 1,737,700 tons. This is 305,000 tons less than in 1913, which was a record year, and 173,835 tons less than in 1912. The total horsepower of machinery for merchant vessels built during the year was 1,473,300. It is interesting to note that 99.85 percent of the merchant tonnage built was steam tonnage, which is about the average for several years past. These figures by no means indicate the state of activity in the English shipyards and engine building works at the present time, as on account of the war conditions the figures for warship construction were withheld, and many of the largest establishments are devoting practically their entire facilities to this work. High speed vessels did not predominate in the year's production, although a number of notably large vessels were launched. The leading place among the shipbuilders fell to Harland & Wolff, Ltd., Belfast, both for the production of the largest tonnage of merchant vessels and also for the largest output of marine machinery. The largest vessel launched during the year was the White Star liner *Britannic*, of 50,000 tons and 60,000 indicated horsepower, built by Harland & Wolff, who also launched the Holland-America steamship *Statendam*, of 33,000 tons and 20,300 horsepower, and the Red Star liner *Belgenland*, of 27,000 tons and 18,400 horsepower. Among the features noted in the year's production were the increasing adoption of the Isherwood system of longitudinal framing and the increasing favor of geared turbines. Two large ships, the *Transylvania* and *Tuscania*, were fitted with this form of propulsion. A third ship, practically a sister ship to the others, is also being fitted with geared turbine drive, but with this difference, superheated steam will be used instead of saturated steam, as was the case in the other vessels. At the present time there are over twenty vessels being fitted with geared turbine drive, including practically every type of ship from the cargo carrier to large passenger vessels, so that this system of propulsion has much to commend itself. Harland & Wolff, however, continue to place reliance on the combination system which they have long advocated. As regards the internal combustion engines of the Diesel type, the firm that has done the most is the Burmeister & Wain Oil Engine Company, of Glasgow, which is associated with Harland & Wolff. Three of the vessels built by Harland & Wolff at their Glasgow works have been fitted with Diesel engines by them and the results have been especially favorable.

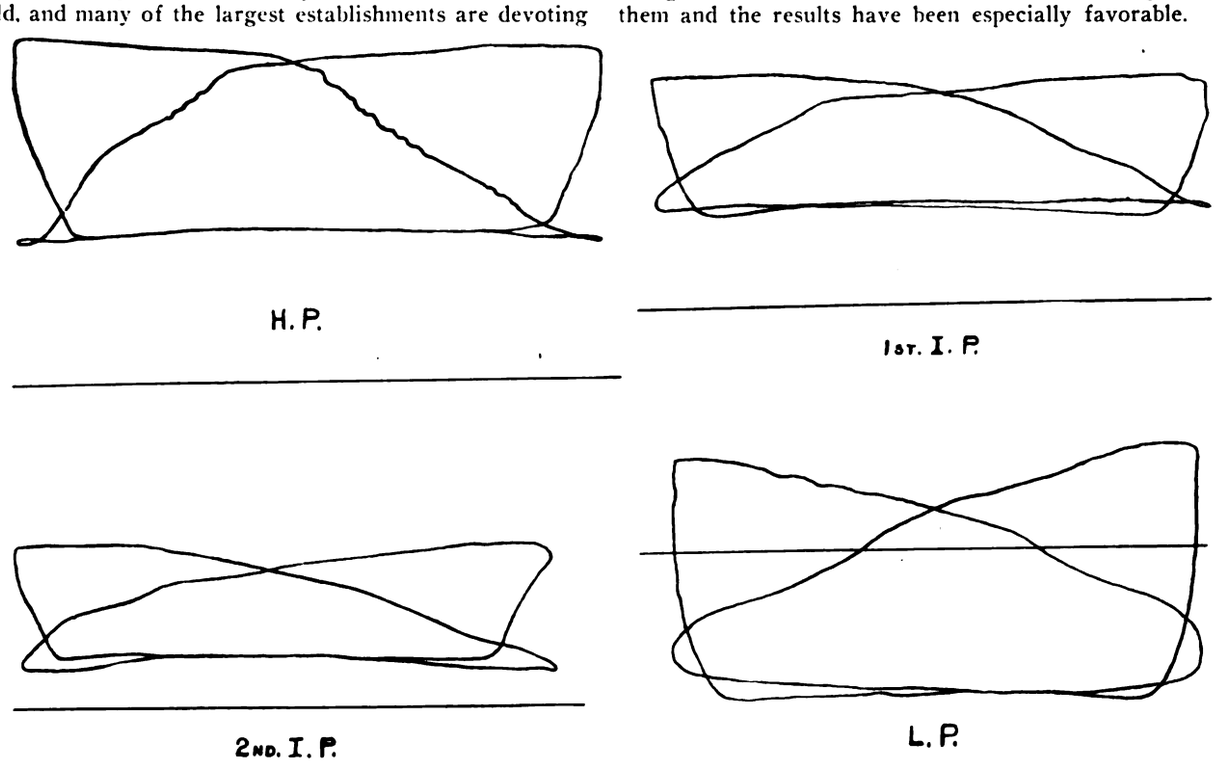

Fig. 16.—Indicator Cards Taken at 11.37 P. M., on Trial Run. Data from Cards Given Below

Boiler pressure	204 pounds
Intermediate pressure[1] rec.	87 "
Intermediate pressure[2] rec.	37 "
Low pressure rec.	9 "
Vacuum	21.5 in.
Revolutions per minute	84.9
Piston speed	594.3
Referred mean effective pressure to low-pressure cylinder	34.4

Cut-offs, high pressure, 3½ in.; intermediate pressure[1], 1¼ in.; intermediate pressure[2], ⅝ in.; low pressure, 0 in.

Mean effective pressure, high-pressure cylinder	82.
Mean effective pressure, intermediate-pressure[1] cylinder	86.25
Mean effective pressure, intermediate-pressure[2] cylinder	15.5
Mean effective pressure, low-pressure cylinder	10.5
Indicated horsepower, high-pressure cylinder	441.
Indicated horsepower, intermediate-pressure[1] cylinder	409.
Indicated horsepower, intermediate-pressure[2] cylinder	369.
Indicated horsepower, low-pressure cylinder	535.
Indicated horsepower, total	1,754.

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A New P. & O. Boat

The first of four interesting vessels built for the P. & O. Company's Eastern trade by Messrs. Cammell Laird & Company, at Birkenhead, has been designed and constructed to the special requirements of the trade in the East, and as may be expected from the amicable relations of the steamship company and the constructing firm the *Khiva* appears to be very well adapted for such purposes. Over sixty years ago, Messrs. Cammell Laird & Company built two of the earliest boats of the P. & O. fleet, the *Nubia* and *Pera*, which were then the largest turned out by the famous Birkenhead shipbuilding firm since its establishment in 1829.

The *Khiva* represents the most recent developments in the P. & O. Company's requirements, for their intermediate passenger vessels. It is 480 feet long, with a beam of 58 feet, and a gross tonnage of about 9,000 tons. The loaded draft is 28 feet, and she has a deadweight capacity of over 10,000 tons. The molded breadth of the vessel is 58 feet, the depth molded is 36 feet 6 inches, the speed is about 14 knots and the indicated horsepower of the engines is about 7,000. Special provision has been made for ventilation in hot climates. Lifeboats are provided for a full complement of crew and passengers.

Built of steel in accordance with Lloyd's 100 A1 class, the *Khiva* has a Board of Trade passenger certificate. Quarters for the native crew are provided in the top gallant forecastle, the bridge and poophouse being fitted up for the accommodation of passengers, officers and engineers. The vessel is divided into eight watertight compartments, the bulkheads all extending to the upper deck. Accommodation is provided for 75 first class passengers in cabins on the upper and bridge decks, and 68 second class passengers in cabins on the bridge deck. Ten powerful cargo winches have been provided for dealing with large quantities of cargo, in addition to four steam cranes, each capable of lifting five tons. Four derricks, each capable of lifting five tons and ten tons, are fitted to two pole masts, and there is also one large derrick forward for lifting a weight of 30 tons.

Refrigerating machinery is fitted and large chambers have been arranged for meat and provisions. The general smoking and music rooms are tastefully decorated and upholstered in first-class style. Electric light has been installed throughout the vessel. A Brown steam tiller operates the rudder, and is controlled by a telemotor gear from the bridge wheel house and flying bridge. A Marconi wireless installation is fitted with a receiving and sending house for the operator on the bridge deck.

The machinery consists of two sets of quadruple-expansion engines, the cylinders being 23½ inches, 34½ inches, 48½ inches and 70 inches diameter by 4 feet 6 inches stroke. They are designed to run at about 95 revolutions per minute, and are balanced on the Yarrow-Schlick-Tweedy principle. Steam is provided by two double-ended and two single-ended boilers at a pressure of 215 pounds per square inch, and the engines are capable of developing about 7,000 indicated horsepower. Howden's system of forced draft is installed. Weir's Uniflux condensers are fitted, and the auxiliary machinery is of the most modern type. The propellers are of the built-up type, with cast iron boss and manganese bronze plates. There is on board a very complete workshop and store room supplied with an electrically-driven lathe, drilling machine and other gear. The machinery spaces have an unusually large number of ventilators to secure cool engine and boiler rooms in the hot climate through which the vessel passes, large up-cast and down-cast electrically-driven fans being fitted in the engine room.

The hull and machinery were designed under the supervision of Messrs. C. G. Deane and R. Leslie, the naval architect and superintendent engineer of the owners. Compared with the *Nubia* and *Pera*, which were 292 feet long, with a beam of 39 feet, a B. M. tonnage of 2,173, and nominal horsepower of 450, the new vessel represents the tremendous advance entailed by modern requirements.

Changes in War Risk Insurance

It is learned from the Bureau of War Risk Insurance, Treasury Department, Washington, D. C., that it is now accepting cotton cargoes to Germany at a rate of 3 percent instead of 5 percent as heretofore.

The bureau has just issued its new schedule of general insurance rates on cargoes and ships, dated Washington, D. C., January 11, 1915, as follows:

Rates from any port in the United States to any port in the world (other than those named in the special list), or vice versa, are as follows:

CARGO, FREIGHT AND ADVANCES

1. Between ports of the United States, its possessions, or any non-belligerent ports in the Western Hemisphere, one-fourth of 1 percent.

2. Between ports on the west coast of the United States and Japan or China, one-fourth of 1 percent.

3. To non-belligerent ports other than above and not north of Havre in Europe, nor east of Sicily in the Mediterranean, one-half of 1 percent.

4. To all other ports, three fourths of 1 percent.

VESSEL (VOYAGE RISKS)

By voyage, meaning from port of loading to not more than two ports of discharge.

1. Between ports of the United States, its possessions, or any non-belligerent ports in the Western Hemisphere, one-fourth of 1 percent.

2. Between ports on the west coast of the United States and Japan or China, one-fourth of 1 percent.

3. To other non-belligerent ports not north of Havre, in Europe, nor east of Sicily in the Mediterranean, one-half of 1 percent.

4. Other ports, three-fourths of 1 percent.

VESSEL (TIME)

Time policies to be issued for a period of ninety days only, rate 1¼ percent.

If the insured agrees to a warranty reading: "Warranted using only non-belligerent ports in the Western Hemisphere," five-eighths of 1 percent.

All rates subject to change without notice and effective from the date thereof. (January 11, 1915.)

LLOYD'S SHIPBUILDING RETURNS.—Lloyd's reports show that 462 vessels of 1,627,316 gross tons were under construction in the United Kingdom at the close of the quarter ended December 31. This is about 96,000 tons less than at the end of the last quarter.

OBITUARY.—Professor Alexander J. Maclean, professor of naval architecture in Webb's Academy and Home for Shipbuilders, Fordham Heights, New York, died December 19 at his home in New York, aged fifty-three years. Mr. Maclean was apprenticed in the British Admiralty Dockyards at Sheerness-on-Sea and later was connected for several years with the United States Navy Yard, Norfolk, Va., and with the William Cramp & Sons Ship and Engine Building Company, Philadelphia, Pa. Professor Maclean was associated with Webb's Academy for eighteen years, and during this time co-operated with J. W. Millard in the design of the Municipal ferryboats for New York city.

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Salvage Work on the Empress of Ireland

A Distinct Advance in Deep-Water Salvage Achievements—Methods Employed and Difficulties Overcome

BY ROBERT G. SKERRETT

The recently completed salvage operations on the sunken steamship *Empress of Ireland* is another example of the courage and the capacity of the skillful diver. The recovery of the mails and bullion aboard that ill-fated craft is an example of submarine engineering that stands out conspicuously because of the extreme difficulties to be overcome in an exceptionally dangerous undertaking.

As most of us know, the collier *Storstad* rammed the *Empress of Ireland* during foggy weather, tearing a great gash in the starboard side of the liner. The injured ship filled quickly and settled to the bottom upon her wounded side. Because of the short time she remained afloat after being struck, hundreds of her passengers were

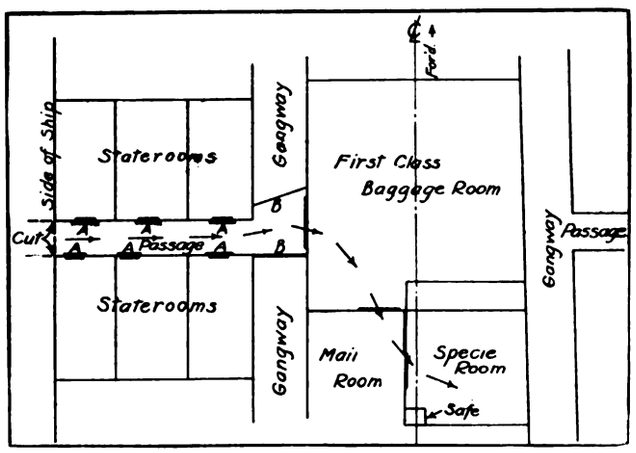

Fig. 1.—Plan of Part of Upper Deck of the *Empress of Ireland*

caught between decks and carried down with the stricken ship. For some time after the catastrophe there was no part of the vessel above water, and the buoys planted, shortly after the sinking, by the Canadian authorities, merely indicated in a general way the place where the *Empress of Ireland* had foundered. This was broadly the situation when the Dominion Government and the Canadian Pacific Railroad took steps toward certain salvage operations.

The Canadian Government wished to recover the mail pouches and the Department of Marine and Fisheries desired later on to have the masts of the wrecked liner removed. This became necessary when the vessel shifted her position and raised her spars right in the path of navigation. Certain of the underwriters, representing shippers and the owners of the craft, desired, if possible, to salve the silver bullion on board and to get out the purser's safe, while the Canadian Pacific Railroad, the owners of the craft, were especially anxious to recover all of the bodies of the passengers that were carried down with the ill-fated ship.

Upon first foundering, the *Empress of Ireland* settled to the bottom in water about 138 feet deep at low tide. At that point in the St. Lawrence the average tidal variation is fully 14 feet, but at times it is even greater, and there is always a very swift current except for the short period of the slack. This, of necessity, added greatly to the difficulties of the task before the salvors, and, as it proved, made it very hard for them even to locate accurately the wreck and to determine the manner in which she rested on the bottom. The water was very cold and the prevalence of light silt made the depths almost black.

Location of the Wreck

When first properly located, the *Empress of Ireland* lay flat on her starboard side, but after a while her cargo shifted and she partly righted herself so that her heel was about sixty degrees toward her wounded side, and, to add to the burdens of the salvors, the vessel sank deeply

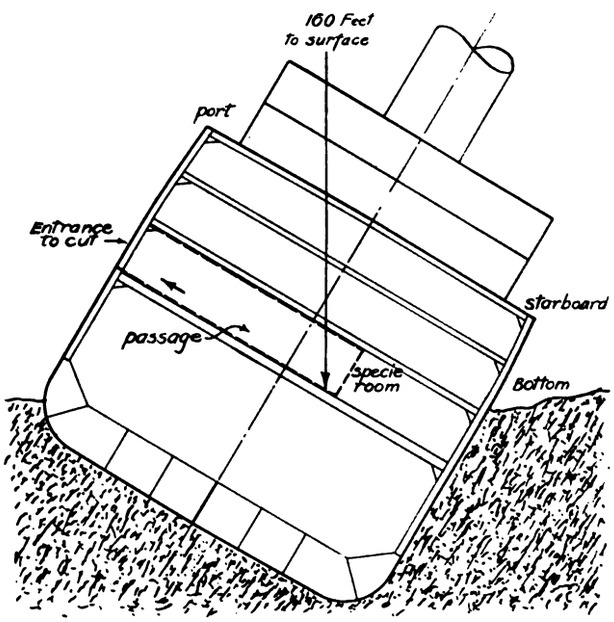

Fig. 2.—Diagram Showing Position of the Vessel

into the soft mud of the river bottom. This state of affairs made the recovery of the bodies in the open deck spaces hard enough, but it measurably increased the perils involved in getting out the dead from inside the ship, and especially in the steerage. It is a fact worth noting, however, that only one diver lost his life during the operations, and his death was due to a slip which dropped him from the wreck into deeper water.

All of the divers engaged in the work were deep-water men, and a dozen of the most skillful and experienced obtainable were secured. Some of these were naval divers from the British cruiser *Essex*. Ultimately the maximum depth in which the divers worked reached a matter of 160 feet, and it was necessary that the greatest care should be taken of the men engaged. Because of the unusual dangers involved, the divers worked in pairs, and as soon as one couple came up from their shift below two others were ready to go down. Their equipment consisted first of diving gear made by Siebe Gorman & Co., afterwards supplemented by diving dress manufactured in the United States. Some important modifications were made in both, and one of them was in the shape of a slot cut in the valve seat of the air supply so that the diver could not shut off

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his air completely. Enough leakage was thus insured to keep him alive until help could reach him.

COMPRESSED AIR EQUIPMENT

The diving practice of the British Admiralty was used as a basis for the operations, and this was amplified by later experiments made in the United States Navy, the latter substituting storage tanks of compressed air for the direct feed from the regulation hand pumps. Indeed, working the latter proved too exhausting even when four men were engaged at the cranks, and it would have been well-nigh impossible to have completed the work in the time actually taken but for the tank system. The salvage vessel, the schooner *Marie Josephine*, was also equipped with a decompression chamber, similar in construction to that used in New York City in tunnel work and in foundation sinking. Happily, the men in charge of the undertaking were thoroughly familiar with compressed air practice in construction work, and their discipline saved the divers from the ill-effects of occasional carelessness. Owing to the coldness of the water, it was found impossible for the men to work with bared hands for any length of time; their fingers became numb. Therefore, they were provided with rubber mittens which were thin enough not to impair seriously the acuteness of their sense of touch, that faculty so vital to the diver when working in dark waters.

Simultaneously with the recovery of the bodies the work preliminary to the actual recovery of the treasure and mails was carried on. The first difficulty in the inky depths was to locate on the slanting port side of the ship the position of the athwartship passage which constituted the natural route to be followed in reaching the specie room and the mail compartment. This passage terminated at the side of the vessel, with nothing more to indicate it than a single air port exactly like many others forward and aft of it. After a good deal of exploring, the divers working toward a common center by approaching from each end of the hull, this particular air port was discovered, but, of course, it was not a sufficient opening for admission into the craft.

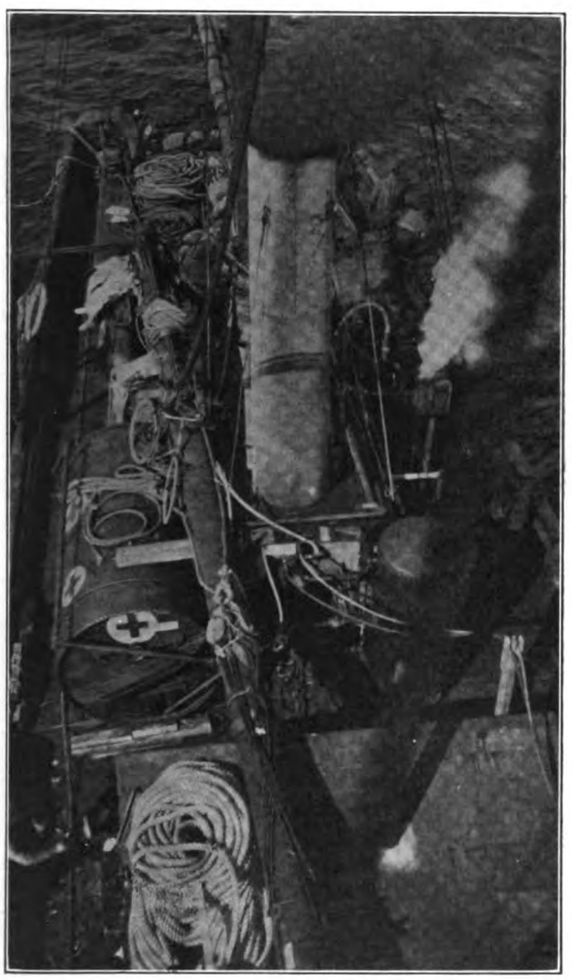

Fig. 3.—Looking Down on Deck of Salvage Vessel *Marie Josephine*

Fig. 4.—Hoisting the Safe Aboard the Salvage Vessel

PNEUMATIC TOOLS USED IN REMOVING PLATING

By permission of the hull underwriters, a cut was made at that point large enough to admit the divers, and the plating was removed by means of a series of holes drilled for the purpose. This particular operation was a noteworthy achievement. The drilling was done in exactly the same way that an opening of that sort would have been made in the shipyard. "Little David" air drills were used, and these pneumatic tools worked admirably at that depth. A proper set-up or backing, or, as it is called in iron work, an "old man," was placed over the spot to be drilled, and the divers worked on the Taylor differential piece-rate system. Despite the hampering conditions under which the divers did their work, the time required for the task

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was but little in excess of that for a similar job in the free air. Don't forget that the ship had a heel of sixty degrees and that electrical submarine lamps gave but a dim illumination in the muddy waters of the St. Lawrence.

With this opening cut in the skin of the ship the problem of removing the bullion, the purser's safe, and the mail pouches was a long way from being solved. The salvors reasonably feared that even so their plan for entering the strong room would not prove feasible, inasmuch as the path to it was decidedly intricate and there were a discouraging number of openings into which the divers might mistakenly turn and get lost or foul their connections leading to the surface. Fig. 1 shows how thoroughly justified the salvors were in their fears. It was realized that the ship's structure intervening between the outside plating and the specie room could be blasted

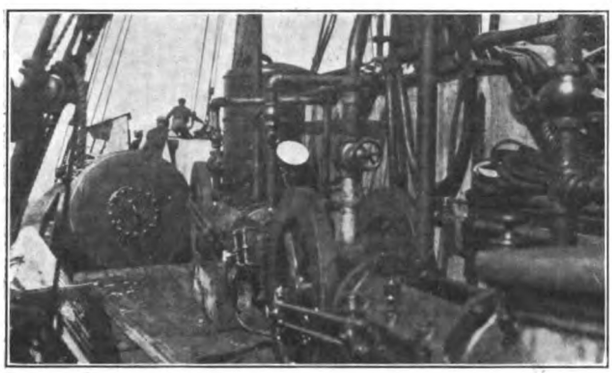

Fig. 5.—Compressors and Storage Tanks

and torn away, but shattered plating and shivered bulkheads would only increase the peril to the divers. Finally it was decided to seal one by one the flanking doorways in the athwartship passage and then to bulkhead off the fore-and-aft gangway so that there would be a straight and solid-walled path to the wide doorway giving admission into the first class baggage-room.

Model Shows Construction of Hull

This was done, and besides giving a direct lead in and out for the divers, void of fouling projections, it offered an easier route for the things to be salved. But before any of the divers were allowed to enter the body of the ship on this quest they were thoroughly drilled by means of a pasteboard model showing the internal structure to be encountered. The men were made to familiarize themselves so thoroughly with the physical conditions of the hull that they could tell with their eyes closed just what was adjacent to them at every point along the route either in entering or leaving the sunken vessel. This precaution, although it consumed some valuable time, proved a wise one in the end, because it not only safeguarded the lives of the divers, but it actually expedited the work of recovering the silver, the safe and the mail pouches.

The purser's safe was set into a niche built especially for it, and even under normal conditions with the steamer afloat it would have been a troublesome thing to dislodge and to get out of the room and on to the deck. With the ship heeled over and sunk, and with her inner body as black as night, obstacles were multiplied. Besides these, the silt that had worked into the vessel made the deck very slippery. The divers themselves could not do any real labor at that depth, and the safe had to be drawn out by power applied at the surface. It should be remembered that the purser's strong box was 160 feet down from the tide level. Hoisting out that safe was a very neat piece of work and had to be controlled exactly at every stage of its journey outward and upward. The pull on the wire rope had to be perfectly steady, and from time to time the hawser was stoppered. The utmost care had to be taken to prevent the line from cutting itself at sharp turns, and these preparations had to be made deliberately and carefully. It was with intense relief that the divers got the safe clear of the hull and gave the signal for a straight haul upward. The work of getting out the bullion was likewise hard because of the position of the specie room, but the ingots could be handled separately and were loaded in a canvas bag and hauled up with reasonable ease.

Divers Communicate Through Telephones

The ordinary signal code of the diving fraternity would have been of little avail for the men when working inside

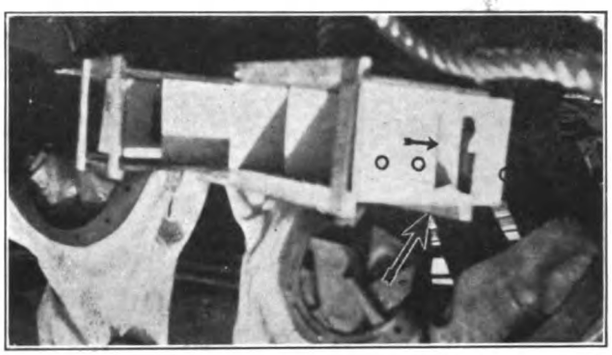

Fig. 6.—Cardboard Model of Ship's Structure Leading to Strong Room. Arrow Indicates Cut in Side of Ship

Fig. 7.—Submarine Telephone Set

of the hull. It was realized at an early stage that telephones would be necessary in order that the divers could be in constant communication with the people at the surface, as well as able to talk to one another through a relaying operator on the salvage craft. The English telephone gear supplied with the Siebe Gorman suits is a very efficient apparatus; but even so, the outfit was considerably altered and improved by the adoption of some modifications in accordance with the latest practice in American telephone engineering. Four of these telephones were used, and they rendered invaluable service.

In this work the Canadian Government employed the Canadian Salvage Association, which has the right to operate by the processes and under the patents owned by the Yankee Salvage Association of New York City. The Canadian Pacific Railroad employed the same company to recover the bodies.

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Electricity on Board Ship

BY J. E. BULLARD*

Electricity is extensively used on shipboard for all purposes requiring light, heat or power. The units employed vary in size all the way from the little two or four-candlepower portable lamp receiving its energy from a battery of six dry cells to the large electric motors which are to be used to propel the new superdreadnought *California*. There are many advantages possessed by electricity for each different application in the three fields—light, heat and power.

LIGHT

There is no boat so small that it need be without electric lights. With a two-candlepower or a four-candlepower miniature Mazda lamp in a portable holder attached to a few feet of lamp cord, and a dry battery of six cells, one will have a light for intermittent service which he will soon consider indispensable. For such service an ignition battery, which has become too weak for ignition purposes, will often be found to serve admirably. A battery of from twelve to sixteen cells will supply current to operate a four-candlepower miniature Mazda lamp from sixty to sixty-five hours. These cells should be connected in series multiple; that is, divided into four groups of four cells each, with the zinc terminal of one cell connected to the carbon terminal of the next cell in groups of four, the zinc terminals at the ends of the several groups connected together and the carbon terminals at the opposite ends also connected together. This makes three or four sets, as the case may be, of four cells each, connected in series, the several sets being connected in multiple.

It may be well to define the words series and multiple as used here. Series connection means that the carbon terminal of one cell is connected to the zinc terminal of the next cell, the carbon terminal of that cell to the zinc of the next, and so on. Multiple connection means that the zinc terminal of one cell is connected to the zinc terminal of the next, and so on. The carbon terminals are connected to each other in the same manner. In this system of connection we have all the zinc terminals connected together and all the carbon terminals connected together. In series connection there is only one wire connecting any one cell to the next cell in the battery. In multiple connection there are two parallel wires connecting any one cell to the next cell in the battery, and for that reason this system is sometimes called parallel connection. Series connection increases the voltage or pressure of electricity, and multiple connection increases the current or quantity of electricity.

An electric light is the only light which it is safe to use around the engine or the gasolene (petrol) tank. When it is such a simple matter to enjoy the use of electricity there is no excuse for endangering life and property as one does when he uses a lantern or other flame light to examine his engine or fuel tank.

Where several lights are required generators can be secured, which can be readily attached to the engine. These generators are automatically controlled and can be used either with or without storage batteries. The storage battery, however, is always desirable, as it furnishes light without the necessity of starting the engine.

Large boats, yachts and ships require lights of all sizes, and all their lighting needs can be met best by the use of electricity. Large searchlights are on the market which are controlled electrically. These lights have two motors in their base which train the beam in altitude and azimuth. These motors are readily controlled from a remote point. This means that the light may be mounted in one part of the boat and controlled from some distant part of the boat.

The safety, cleanliness, convenience, reliability and ease of control of electric lighting recommend it very highly to the marine engineer and naval architect. This statement is borne out by the fact that the new Argentine battleship *Moreno* has a grand total of 3,000 electric lights.

A motor boat of forty to forty-five feet in length can be well lighted by twelve four-candlepower lamps. The running lights and the anchor light would each contain a six-candlepower lamp, the binnacle light a two-candlepower lamp and the searchlight one of twenty-candlepower—a total of one hundred candlepower. The power necessary to supply current to these lamps would be only about one-fifth of a horsepower. A storage battery of one hundred ampere-hours would run the lights continuously for about eight hours.

HEAT

Electric cooking equipment is so well adapted for use on shipboard that there are large steamships on which all coal and oil fires for cooking purposes have been eliminated. Perhaps the largest installation now in actual operation is that on board the U. S. battleship *Texas*. The electric ranges on this battleship have been in operation since March 12, 1914, and since that time have served three meals a day to a crew of 900 men and to 70 officers.

The equipment consists of ten electric ranges, in the general mess galley, five in the officers' galley, and two bakers' ovens. Coffee, tea, boiled meats and vegetables for the general mess are prepared in steam jacketed caldrons, and therefore do not require the operation of the electric ranges. In the officers' galley, where less food is prepared, electricity is used exclusively for cooking, and even for boiling.

Some idea of the magnitude of the cooking operations which must be carried on to feed the crew of 900 men is gained by the knowledge that over 6,000 pounds of bread alone is consumed each week, that a breakfast may require 180 dozen fried eggs, and a dinner 600 pounds of roast meat.

Mr. G. L. King, first-class cook on the *Texas*, states that he considers the electric range far superior to the coal-fired type. (1) The use of the electric type eliminates the necessity of handling coal and ashes, consequently there is less dirt present in the room where the food is prepared; (2) the electric range is much cooler to work around, the heat being hardly noticeable even on hot days; (3) it is much easier to cook with the electric equipment, as the temperature is uniform.

POWER

Electricity is now used on shipboard for every purpose requiring power. On the new Argentine superdreadnought *Moreno* we find 275 motors having a total rated horsepower capacity of 4,000, and varying in size from the little one-third horsepower motor driving the vacuum cleaner, and the half-horsepower motors driving the speed signal balls, the ozonizer pumps, and the meat slicer, to the one hundred and fifty horsepower motors driving the coaling winches and steering gear.

The current for these motors is supplied by four 375 kilowatt turbo-generators of the horizontal type. Two of these machines are located forward and two aft on the lower platform deck below armor. On the gun deck there is a dynamo room containing two Diesel oil-engine-driven generators of 75 kilowatt capacity for harbor use when the fires are drawn. The more general adoption of the modern high-speed steam turbine for ship propulsion,

* Member of the Society for Electrical Development.

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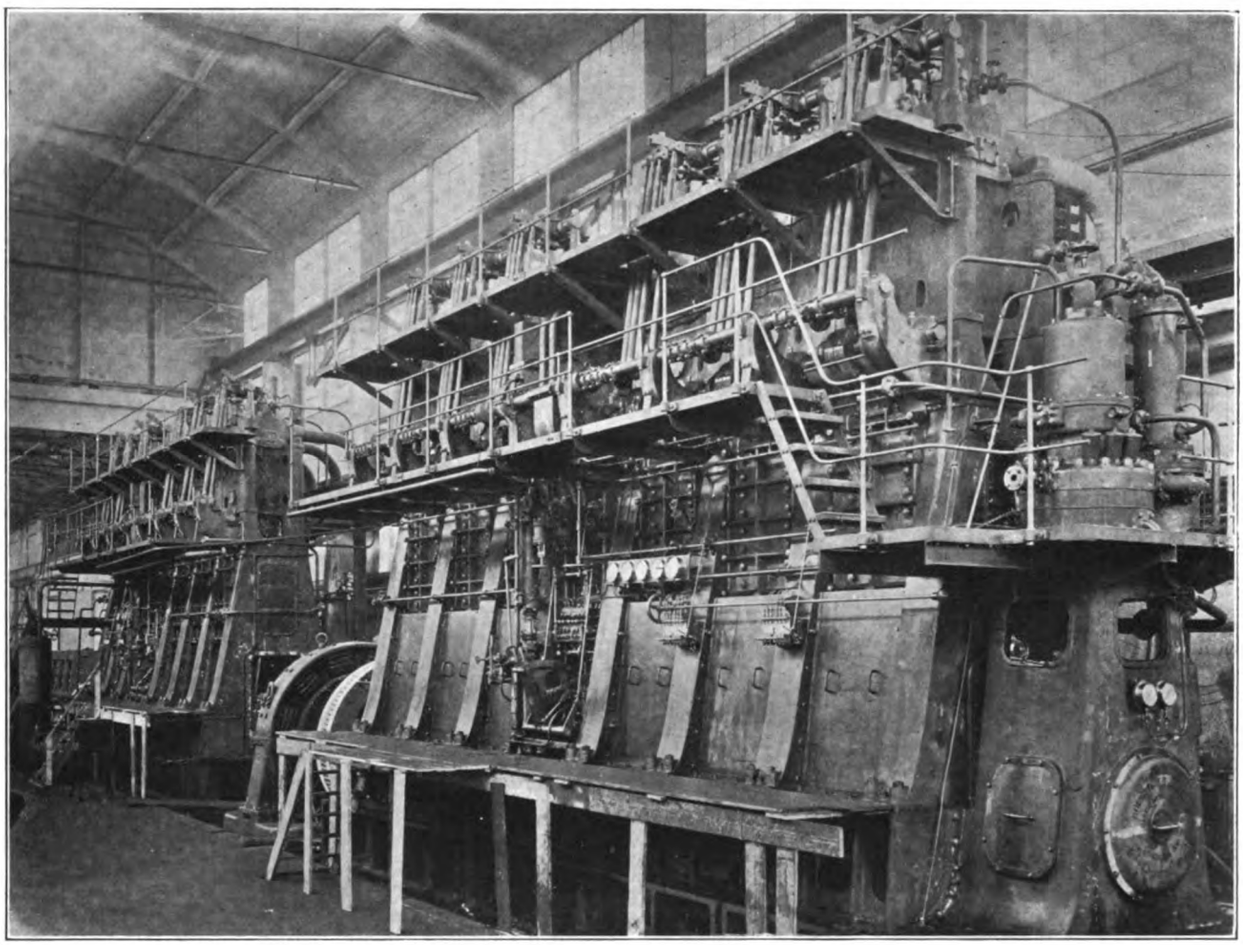

Fig. 1.—Six-Cylinder Diesel Engines, Built by Burmeister & Wain for the Motor Ship *Tongking*

which aside from its high speed appears to be the ideal steam engine for this purpose, has been delayed by the difficulty experienced in manufacturing reduction gearing which is sufficiently reliable, noiseless and efficient. This has caused many investigators to turn to electricity for the solution of the problem. As a result we find in the United States Navy the collier *Jupiter* with turbine electric propulsion. The steam turbine drives generators which furnish electricity to the motors connected to the propeller shafts. This permits of the turbine speed being as high as efficient operation requires, and the placing of the turbines in any convenient part of the ship without regard to the propeller shafts. This system has proven so satisfactory on the *Jupiter* that the Secretary of the Navy has authorized the installation of a steam turbine electric propelling plant on the superdreadnought *California*, which will be built at the New York navy yard.

Motor Ship Tongking

The official trip of the *Tongking*, the eleventh large, ocean-going, motor ship built by Burmeister & Wain, at Copenhagen, Denmark, was carried out successfully in the Copenhagen Sound, October 7. This vessel is a sister ship to the *Siam*, *Annam* and *Malakka*, all belonging to the East Asiatic Company here, and has the following dimensions: Length between perpendiculars, 410 feet; breadth, 55 feet; depth, molded, 30 feet 6 inches; deadweight capacity, 9,700 tons.

The engine installation in the *Tongking* is quite similar to the installation in the *Malakka*, but differs from the engines in the *Siam* and *Annam* in that the latter have eight cylinders each and develop a total of 3,000 indicated horsepower for each ship, while the engines in the *Tongking* and *Malakka* have six cylinders each and develop 3,100 indicated horsepower. Each engine is fitted with its own main compressor, manufactured by Burmeister & Wain. These compressors have such a capacity that each gives sufficient air for the injection of fuel and a further surplus for filling up the maneuvering reservoirs, for the whistle and for the oil burner for the heating boiler. The main engines are of the same general type as those installed in the *Fionia*, although somewhat smaller, developing 3,100 indicated horsepower as against 4,000 indicated horsepower for the *Fionia*.

As in the previous motor ships built by Burmeister & Wain, all the auxiliary machinery is electrically driven, and all the pumps are independent of the main engines. The auxiliaries include two cooling water pumps, two pumps for forced lubrication, and two sets of bilge, sanitary and piston cooling pumps. All these pumps have such a capacity that it is only necessary to have one set running at a time, while the other stands by as a spare.

The pistons of the main engines are cooled by sea water, which is conducted to and from the pistons by means of telescopic pipes, according to the same system as adopted for the larger engines in the *Fionia*, as this arrangement during the first voyage of this ship to Bangkok has proved to be thoroughly satisfactory.

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Because each main engine is fitted with a main compressor, the auxiliary engine installation is somewhat different from the installations in the *Siam* and *Annam,* where the auxiliary engines drive the compressors. On board the*Tongking* and *Malakka* there are installed three two-cylinder auxiliary Diesel engines, directly coupled to dynamos, each having a capacity of 90 brake horsepower. This arrangement gives a very high degree of reliability of the working of the auxiliary machinery, which is all electrically driven. During normal speed at sea the power consumption is about 50 brake horsepower. Two of the auxiliary engines are always running, while the third is standing by as a spare, so that a sudden closing down of one of the engines will cause no interruption of the working, as the other engine will easily be able to take the whole load. When loading and unloading with all winches working, two of the engines are kept running, these being able together to give the maximum power for the winches; the third engine is therefore always standing by as a spare.

During the trial trip a speed of 12.71 knots was attained on a horsepower of 3,328. The oil consumption was 149 grammes of ordinary Borneo crude oil, including the consumption of fuel for the auxiliary engines. It is noteworthy that during the trial trip the whole engine installation worked quite satisfactorily, although the engines had not previously been given a shop test. After the trials the ship was accepted by the owners, the East Asiatic Company, and taken into the Copenhagen free port to receive a cargo. She started on her maiden voyage from Copenhagen to China and Japan on October 10.

While the *Tongking* is the eleventh big ocean-going motor ship built by Burmeister & Wain, this firm now has in hand another large motor ship for Rederiaktiebolaget "Nordstjernan," Stockholm. This vessel is a sister ship to the *Suecia, Pedro Christophersen, Kronprins Gustaf Adolf* and *Kronprinsessan Margareta,* and will be completed at the end of this year.

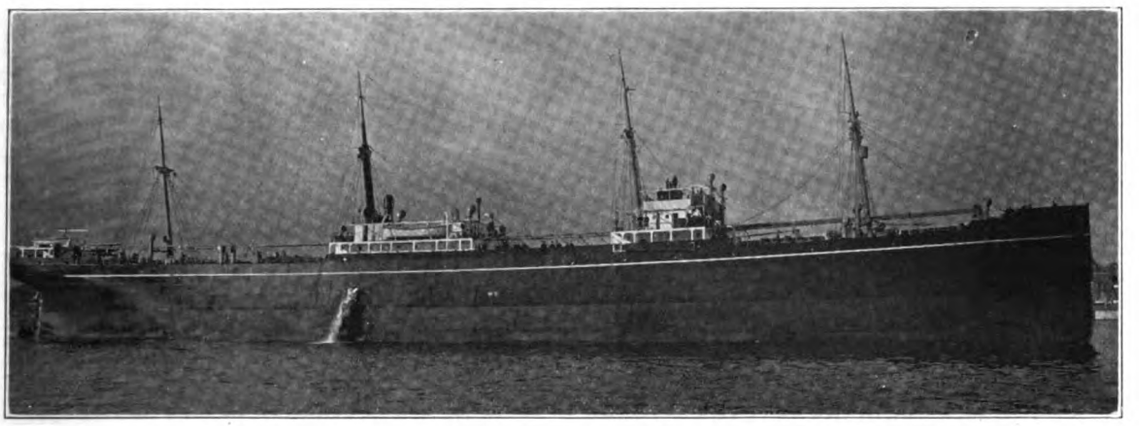
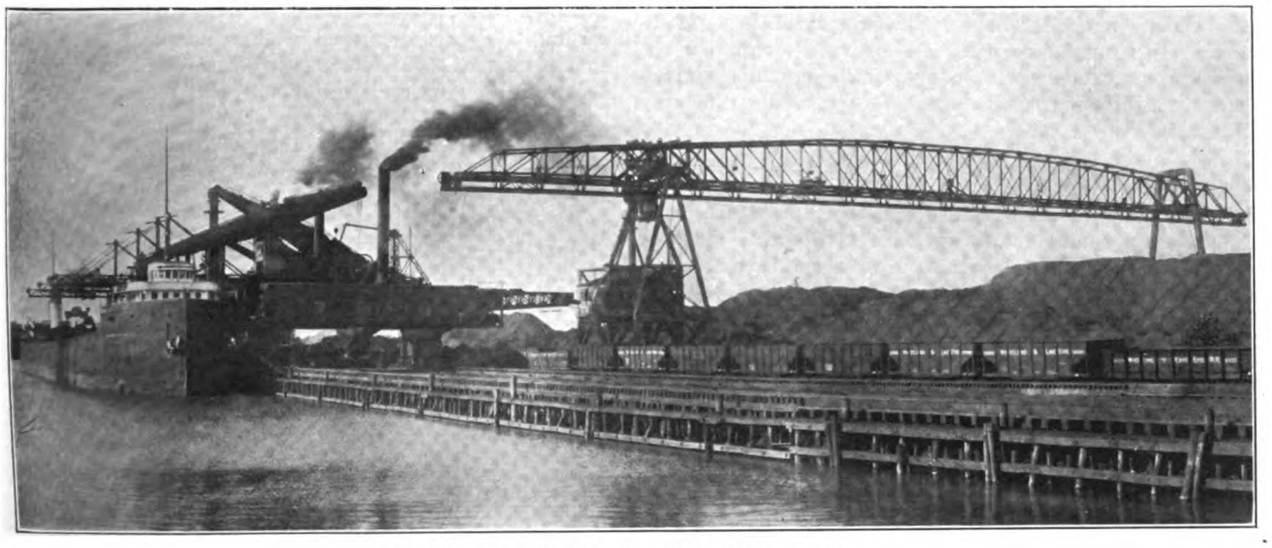


Fig. 2.—Motor Ship *Tongking.* Length 410 Feet, Beam 55 Feet, Deadweight Capacity 9,700 Tons

New Ore Unloading Plant at Huron

A steam-operated ore unloading plant with a guaranteed capacity of 660 tons per hour was recently installed by the Wellman-Seaver-Morgan Company, Cleveland, Ohio, for the Wheeling & Lake Erie Railroad, at Huron, Ohio. This plant consists of two 15-ton capacity Hulett unloaders and represents the highest development in ore unloading machines of the steam-operated type. A steam-operated plant was installed on this dock, for the reason that there was no available electric power for operating the machines.

The unloaders, which are of the well-known Hulett type, consist essentially of heavy steel framework elevated on gantry legs which are mounted on trucks designed to



Wheeling and Lake Erie Ore Plant at Huron, Ohio

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travel along the runway on the dock. The girders of this main framework are extended back of the rear runway so that ore can be discharged under this cantilever, to be reclaimed by a bridge spanning the ore storage yard. The main girders of the machine span yard tracks between the front and rear runway, and ore can be discharged from the machine either into cars standing on these tracks or into the temporary storage pile under the cantilever.

Mounted on the main girders and traveling on rails supported by them is a heavy trolley carrying a walking beam from the outer end of which is supported a rigid bucket leg which terminates at the lower end in a Fickinger-Blake patented bucket having a capacity of 15 tons.

The walking beam supporting the bucket leg is of such length that with the trolley in the forward position and the open bucket shells at the water level, the maximum reach of the machine is approximately 50 feet 7 inches, this reach being sufficient to unload ore from any of the largest ore-carrying boats on the Great Lakes. Located between the main girders and running on a track extending their entire length is the conveyor car, which is used for the purpose of transferring the ore from the bucket into cars or storage, as desired.

The conveyor car, when at the forward end of its runway, is in such position that the ore can be dumped directly into it from the bucket, and the car is then drawn back by means of ropes to the desired position for dumping.

Steam Power Plant

Power for operating the machine is supplied by means of a 275 horsepower locomotive type boiler, which is located in a boiler house at one side of the main girders. This boiler supplies steam for operating the haulage engines for the conveyor car, and also for supplying steam to the pump and water accumulator, for supplying the operating cylinders which control the motions of the trolley, walking beam, bucket leg and bucket, these motions being hydraulically controlled.

The steam is carried from the boiler to the pump and accumulator by means of a walking pipe at the side of the trolley. This pipe is supplied with the necessary swivels and is of such length that it will accommodate the extreme travel of the trolley. The main trucks of the machine are ten in number, five under the forward leg and five under the rear leg. Four of the trucks under each leg are carried in pairs on heavy steel equalizing beams in the sill girders. The fifth truck is carried on springs and is located under the outside girder, supporting one side of the boiler house. Two trucks on the front leg and two on the rear leg are provided with driving gears and connected to the conveyor car haulage engine, which is also used for the purpose of traveling the machine along the dock.

The Trolley

The trolley is mounted on twelve wheels at the forward side and four wheels at the rear side, two of the rear wheels being underrunning on a track provided for this purpose to prevent the uplift at the rear end of the trolley when the machine is working at full load conditions. The forward trolley wheels are mounted on springs in the truck frames. The trolley is moved back and forth on its runways by means of ropes which are controlled by two hydraulic cylinders of the plunger type, which are provided with a common crosshead in which are mounted sheaves for the trolley rope. The necessary multiplication of parts is obtained by passing these ropes around sheaves carried in the trolley framework, and the ends of the rope are secured to each end of the trolley runway.

At the top of the trolley framework are heavy bearings which carry the walking beam trunnions. The walking beam is raised and lowered by means of a single plunger type cylinder, provided with a crosshead at the outer end, and in this crosshead are mounted sheaves around which the beam hoist ropes are passed, the ends of the rope being attached to the back end of the trolley framework. The outer end of the walking beam is out of balance to such an extent that the bucket leg descends by gravity.

The bucket leg is mounted on a swivel bearing carried on trunnions in the forward end of the walking beam, this swivel being so arranged that the bucket leg can be rotated a three-fourth revolution either way from central position. The motion of rotating is controlled by ropes operated by a double cylinder of the plunger type, which is located at the rear on the top of the walking beam. This motion of rotation of the bucket leg enables the operator to turn the bucket in any position to facilitate the unloading of ore from the boat.

Operation of the Bucket

The bucket at the lower end of the leg is of the Fickinger-Blake type and is operated by means of cylinders located in the bucket leg. All the motions of the bucket, walking beam and trolley are controlled by the operator, who is stationed in the bucket leg directly over the bucket. Convenient to this position are located the pilot valves for operating the main valves controlling the various operating cylinders. The water for operating these machines is snpplied by means of a Worthington compound pressure type pump, which supplies water to a steam hydraulic accumulator located at the rear of the trolley. The capacity of this pump is sufficient to supply water to all of the cylinders in sufficient quantity to operate the machine at its maximum speeds.

In addition to the operator in the bucket a second operator is required, who has control of the conveyor car and the moving of the machine along the dock.

These machines have a guaranteed capacity of 330 tons per hour for each machine, based on unloading the entire cargo of modern boats. Their capacity for unloading in free ore, however, is very much in excess of the above amount, as the capacity of the machine is very materially decreased after the ore has been unloaded to such a point that shoveling is required in order to clean up the cargo.

Bureau of Navigation Shipbuilding Returns.—According to figures published by the Bureau of Navigation, Department of Commerce, 1,163 vessels of 255,630 gross tons were built in the United States in 1914 as compared with 1,501 vessels of 382,569 gross tons built in 1913. Eighty-six steel steamships aggregating 157,496 gross tons were built in 1914, as compared with 114 aggregating 229,327 gross tons in 1913. For the six months ended December 31, 516 vessels of 107,901 gross tons were built, as compared with 644 vessels of 163,849 tons in the corresponding period a year ago. In the month of December 62 ships of 15,103 gross tons, built in United States shipyards, were officially numbered, five of them aggregating 10,385 gross tons being steel steamships. Sixteen foreign-built ships of 59,805 gross tons were also added to the American merchant fleet during the month in accordance with the Act of August 18, 1914.

Annual Meeting.—The annual meeting of the National Association of Engine and Boat Manufacturers, Inc., will be held at 11 A. M. February 4 at 29 West Thirty-ninth street, New York.

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New Fruit Carrying Steamer van Hogendorp

Steamer for the Atlantic Fruit Company's New Service Between Central America, and the West Indies and Europe

BY FREDERICK C. COLEMAN

The Atlantic Fruit Company, of New York, originally formed to consolidate a number of steamship and fruit importing companies with other interests in the fruit-growing trade, now owns valuable tracts of banana-growing lands, as well as possessing extensive rights and privileges over other tracts of country, through all of which there are railways connecting the plantations with the seaboard. Supplies of fruit have been drawn not only from Jamaica and Cuba, but from Colombia, Honduras, Nicaragua, Mexico and other parts of Central America.

With the object of further developing this business, the Atlantic Fruit Company recently effected a combination of powerful commercial interests in the United States, Great Britain, Canada, the West Indies, Germany and Holland, and arranged for Messrs. Wambersie & Son, merchants and shippers, of Rotterdam, to act as the selling agents and distributors for Europe, and also as the managers of three new steamships intended to inaugurate a service between Central America and the West Indies and Europe.

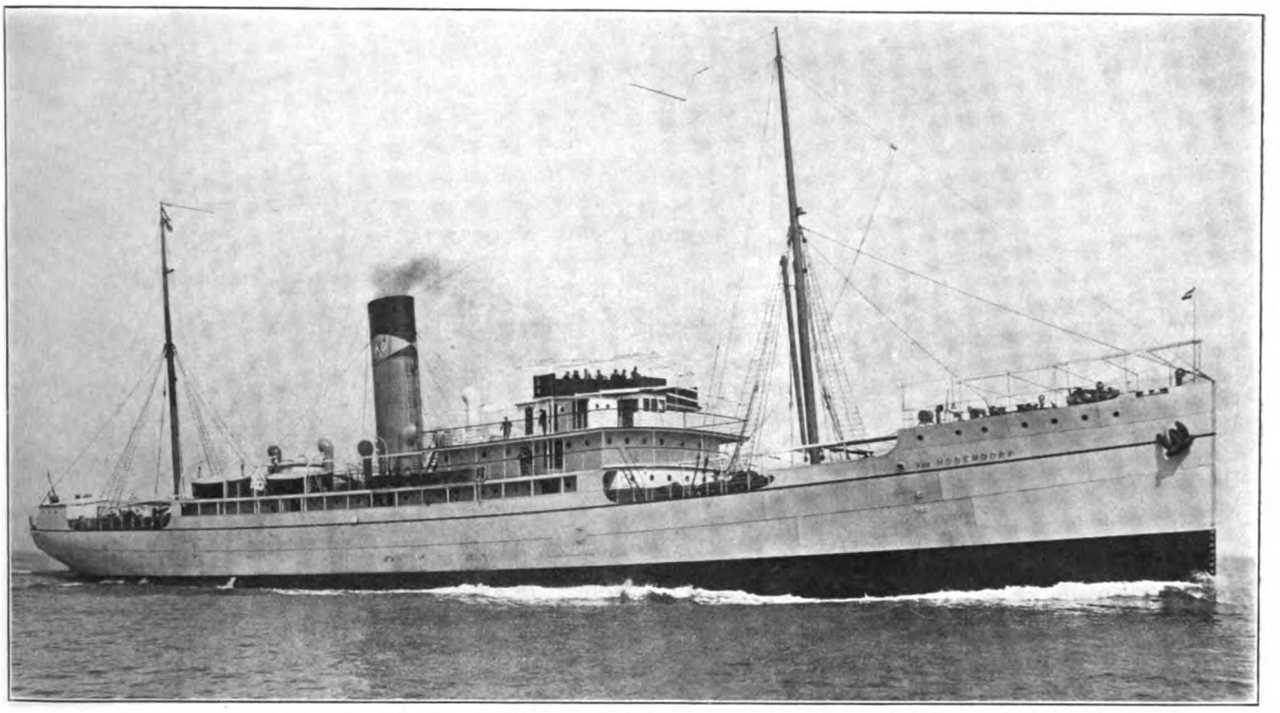

Fig. 1.—*S. S. van Hogendorp*, Built for the Atlantic Fruit Company by Swan, Hunter & Wigham Richardson, Ltd.

The order for these three fruit-carrying steamships was placed early in the year (1914) with Messrs. Swan, Hunter & Wigham Richardson, Ltd., of Wallsend-on-Tyne, and on this and the following pages is illustrated the *van Hogendorp*, the first vessel to be delivered. The remaining two vessels were named *van der Duyn* and *van Stirum*. These steamships, named after three eminent statesmen who, in 1813, were instrumental in restoring the throne of the Netherlands to the House of Orange, will be of uniform dimensions and equipment, and will each measure 343 feet in length overall, 331 feet between perpendiculars, 45 feet in width, with a molded depth of 20 feet 1½ inches to the upper deck and 28 feet to the awning deck. Each will have a straight stem, a round or elliptical stern, complete awning deck and full top-gallant forecastle, and will be built to Lloyds highest class, and also to the requirements of the British Board of Trade and the Dutch Shipping Law.

Propelling Machinery

The propelling machinery consists of triple expansion direct-acting surface-condensing engines, 23, 38 and 63 inches in diameter by 39-inch stroke, supplied with steam by three single-ended cylindrical multitubular boilers, 15 feet 3 inches diameter by 11 feet 6 inches length, fitted with Howden's forced draft and working at 180 pounds pressure. The total heating surface is 7,300 square feet. The engines and boilers of the *van Hogendorp* were built at the Neptune Works of Messrs. Swan, Hunter & Wigham Richardson, Ltd., and on official trials they gave complete satisfaction when a speed of 14 knots was attained on the measured mile off Tynemouth.

Passenger Accommodations

In addition to carrying fruit these steamships will each have accommodation for 30 passengers. On the boat deck are cabins-de-luxe, furnished with separate bedsteads, wardrobes and toilet tables, and communicating with sitting rooms provided with writing tables, couches and armchairs. Bathrooms adjoin these special cabins. On the same deck is a handsome smoke room paneled in fumed oak and upholstered in leather. Near the smoke

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room is a prettily furnished music room or lounge. On the awning deck are suites of commodious staterooms and close at hand is the dining room, the walls of which are finished in white with lightly decorated panels. The captain and officers have their quarters in a deckhouse on the navigating bridge, and the engineers have their apartments on the awning deck on each side of the engine room casing, while the sailors and firemen are accommodated in the forecastle.

Refrigerating Machinery

The carbon-dioxide refrigerating plant, supplied by the Haslam Foundry and Engineering Company, Ltd., of Derby, is capable of maintaining a temperature of from

Cargo Holds

The whole of the fruit spaces are divided into sections, forming bins, and giving about nine bins in each space. The uprights dividing the ship in a fore and aft direction are spaced 4 feet apart, except in the way of hatches. Suitable posts are placed at the corners of the bins, where portable battens are fitted, supported by the ship's stanchions. The bin posts are of the built-up type and in many instances the division battens are portable. Fore and aft battens, 5 inches by 1½ inches, run through mortises cut in the uprights and spaced about 6 inches apart, leaving a space below the lowest batten to the top of the grating, and of about 9 inches above the top batten, to the under-

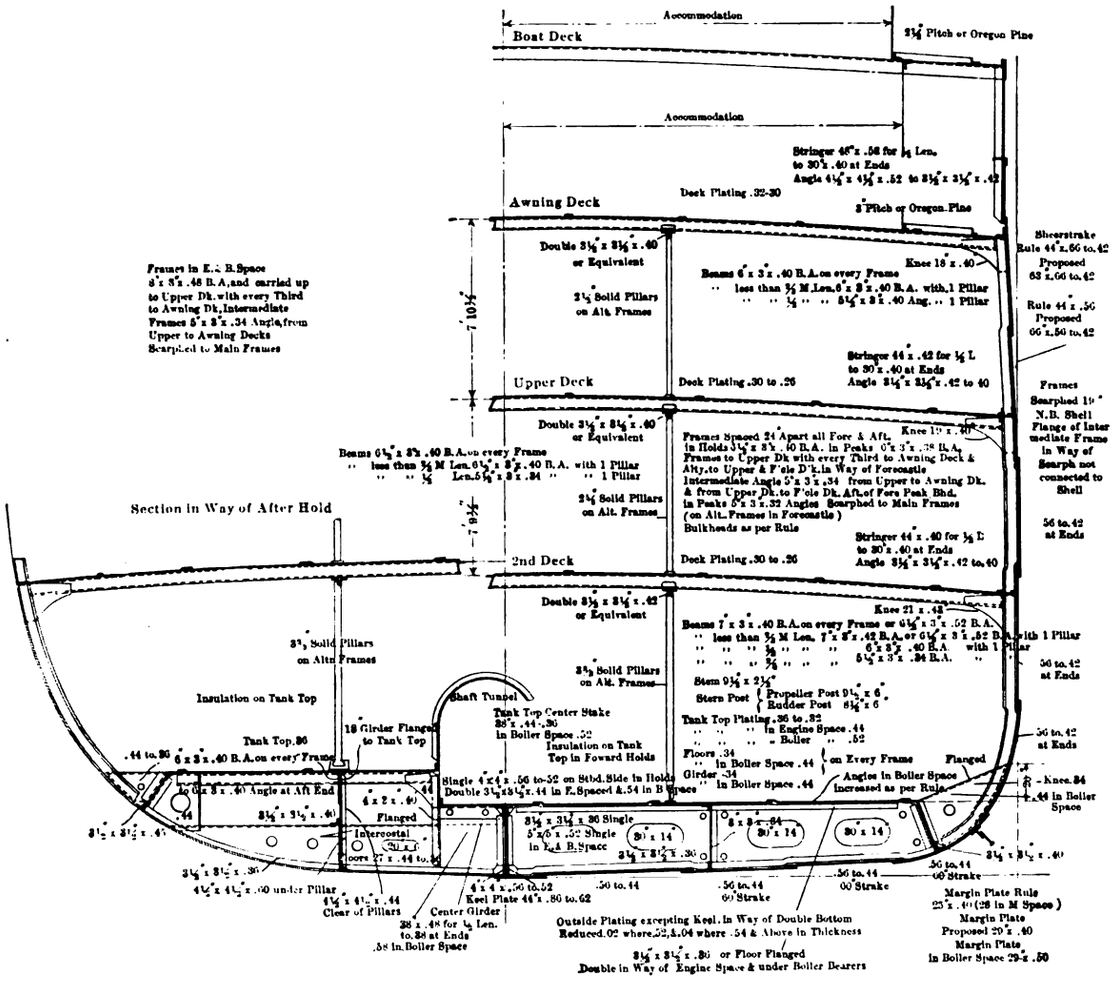
Accommodation
Boat Deck
2½" Pitch or Oregon Pine
Accommodation
Awning Deck
Upper Deck
2nd Deck
Section in Way of After Hold
Deck Plating .32-30
Deck Plating .30 to .26
Shaft Tunnel
Insulation on Tank Top
Tank Top Center Strake
Tank Top Plating .36 to .32
Floors .34
Girder .34
Stem 9½" x 2½"
Stern Post
Propeller Post 9½" x 6"
Rudder Post 8½" x 6"
Flanged
Knee 18" x .40
Knee 21" x .42
Sheerstrake
Rule 44" x .56 to .42
Proposed
63" x .66 to .42
Rule 44" x .56
Proposed
66" x .56 to .42
Frames
Scarphed 19"
N.B. Shell
Flange of Intermediate Frame
in Way of
Scarph not
connected to
Shell
56 to .42
at Ends
Keel Plate 44" x .80 to .62
Outside Plating excepting Keel, in Way of Double Bottom
Reduced .02 where .52, & .04 where .54 & Above in Thickness
Margin Plate Rule
25" x .40 (28 in M Space)
Margin Plate
Proposed 20" x .40
Margin Plate
in Boiler Space 29" x .50
Double in Way of Engine Space & under Boiler Bearers
Center Girder
Clear of Pillars
Intercostal
Insulation on Tank
Top in Foward Holds
Tank Top .36
Girder in Boiler Space .44
Floors in Boiler Space .44
Angles in Boiler Space
Increased as per Rule
Knee .84
.44 in Boiler
Space
Frames in E. R. Space
3" x 3" x .46 B. A. and carried up
to Upper Dk. with every Third
to Awning Dk., Intermediate
Frames 5" x 3" x .34 Angle, from
Upper to Awning Decks
Scarphed to Main Frames
Beams 6½" x 3½" x .40 B.A. on every Frame
Frames Spaced 24" Apart all Fore & Aft.
in Holds 5½" x 3½" x .40 B.A. in Peaks 6" x 3" x .38 B.A.
Frames to Upper Dk with every Third to Awning Deck &
Alty. to Upper & F'cle D'k. in Way of Forecastle
Intermediate Angle 5" x 3" x .34 from Upper to Awning Dk.
& from Upper Dk. to F'cle Dk. Aft. of Fore Peak Bhd.
in Peaks 5" x 3" x .32 Angles Scarphed to Main Frames
(on Alt. Frames in Forecastle)
Bulkheads as per Rule
Double 3½" x 3½" x .60
or Equivalent
3½" Solid Pillars
on Alt. Frames
Double 3½" x 3½" x .40
or Equivalent
Double 3½" x 3½" x .42
or Equivalent
Single 4" x 4" x .56 to .52 on Stbd. Side in Holds
Double 3½" x 3½" x .44 in E. Spaced & .54 in B. Space
3½" x 3½" x .36 Single
5" x 6" x .52 Single
in E. & B. Space
Stringer 46" x .56 for ½ Len.
to 30" x .40 at Ends
Angle 4½" x 4½" x .52 to 3½" x 3½" x .42
Stringer 44" x .42 for ½ L
to 30" x .40 at Ends
Angle 3½" x 3½" x .42 to 40
Stringer 44" x .40 for ½ L
to 30" x .40 at Ends
Angle 3½" x 3½" x .42 to .40
Beams 7" x 3" x .40 B.A. on every Frame or 6½" x 3" x .52 B.A.
less than ½ M Len. 7" x 3" x .42 B.A. or 6½" x 3" x .52 B.A. with 1 Pillar
6" x 3" x .40 B.A. with 1 Pillar
5½" x 3" x .34 B.A.
Beams 6" x 3" x .40 B.A. on every Frame
less than ½ M Len. 6" x 3" x .40 B.A. with 1 Pillar
5½" x 3" x .40 Ang. 1 Pillar
Beams 6½" x 3½" x .40 B.A. on every Frame
less than ½ M Len. 6½" x 3½" x .40 B.A. with 1 Pillar
5½" x 3½" x .34 Angle with 1 Pillar
2½" Solid Pillars
on Alt. Frames
3½" Solid Pillars
on Alt. Frames
Tank Top .36
.44 to .36
6" x 3" x .40 B.A. on every Frame
6" x 3" x .40 Angle at Aft End
18 Girder Flanged
to Tank Top
4" x 2" x .40
8½" x 3½" x .40
3½" x 3½" x .44
3½" x 3½" x .36
4½" x 4½" x .60 under Pillar
4½" x 4½" x .44
Floors 27" x .44 to .36
30 x 14
80 x 14
8" x .84
4" x 4" x .56 to .52
.50 to .44
.56 to .44
60 Strake
38" x .48 for ½ Len.
to .38 at Ends
.58 in Boiler Space
3½" x 3½" x .36 or Floor Flanged

Fig. 2.—Midship Section

50 to 55 degrees, and is fitted in a house on the awning deck abaft the engine casing. The air cooler for the after holds is fitted in a house adjoining the machine room, while the cooler for the forward holds is arranged in the upper 'tween decks at the fore end of the boiler casing.

The outer boundaries of the fruit carrying spaces—that is to say, the ship's side, tank and tunnel tops, shelter deck and end bulkheads, are insulated by granulated cork, and portable sections are arranged at the wing limbers in the hold and also in the way of tank manholes. There are insulated covers to the awning deck hatch, besides the ordinary covers, fitted in sections to suit fore and afters. Spar gratings are arranged to all the decks on which fruit will be laid.

side of the beams. The uprights in the way of the hatches and those which divide the space athwartship are distanced about 5 feet apart. All battens which divide the bins in an athwartship direction and which are portable are arranged so that the battens may be put in place and afterwards prevented from moving about. Portable battens also pass through mortises cut in the uprights.

The steel bulkheads in each space are lined, where not insulated, with battens similar to those dividing the bins. A fruit cage is placed in one corner of each hatch in each 'tween deck and on the hold for breaking out cargo. These cages are built with angle frames, 2½ inches by 2½ inches by ¼ inch, and the sides are sparred similar to the bins, the spars in the bottom of the cage having a space of 1 inch between them.

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AUXILIARIES

Electric light is installed throughout the ship, the generator being by Messrs. W. H. Allen, Son & Co., Ltd., of Bedford, and the dynamo by the India Rubber & Gutta Percha & Telegraph Works Company, Ltd., of Silvertown, London, E. The steering gear is by Messrs. John Hastie & Co., Ltd., of Greenock. Rapid loading and discharging of fruit cargoes is effected by means of a number of steam winches and derricks, five of the winches being supplied by Messrs. John Lynn & Co., of Pallion, Sunderland, and the windlass is of Clarke, Chapman & Co.'s manufacture. The contractors for the steam heating of these vessels were Messrs. R. B. Charlton & Co., of Newcastle-on-Tyne.

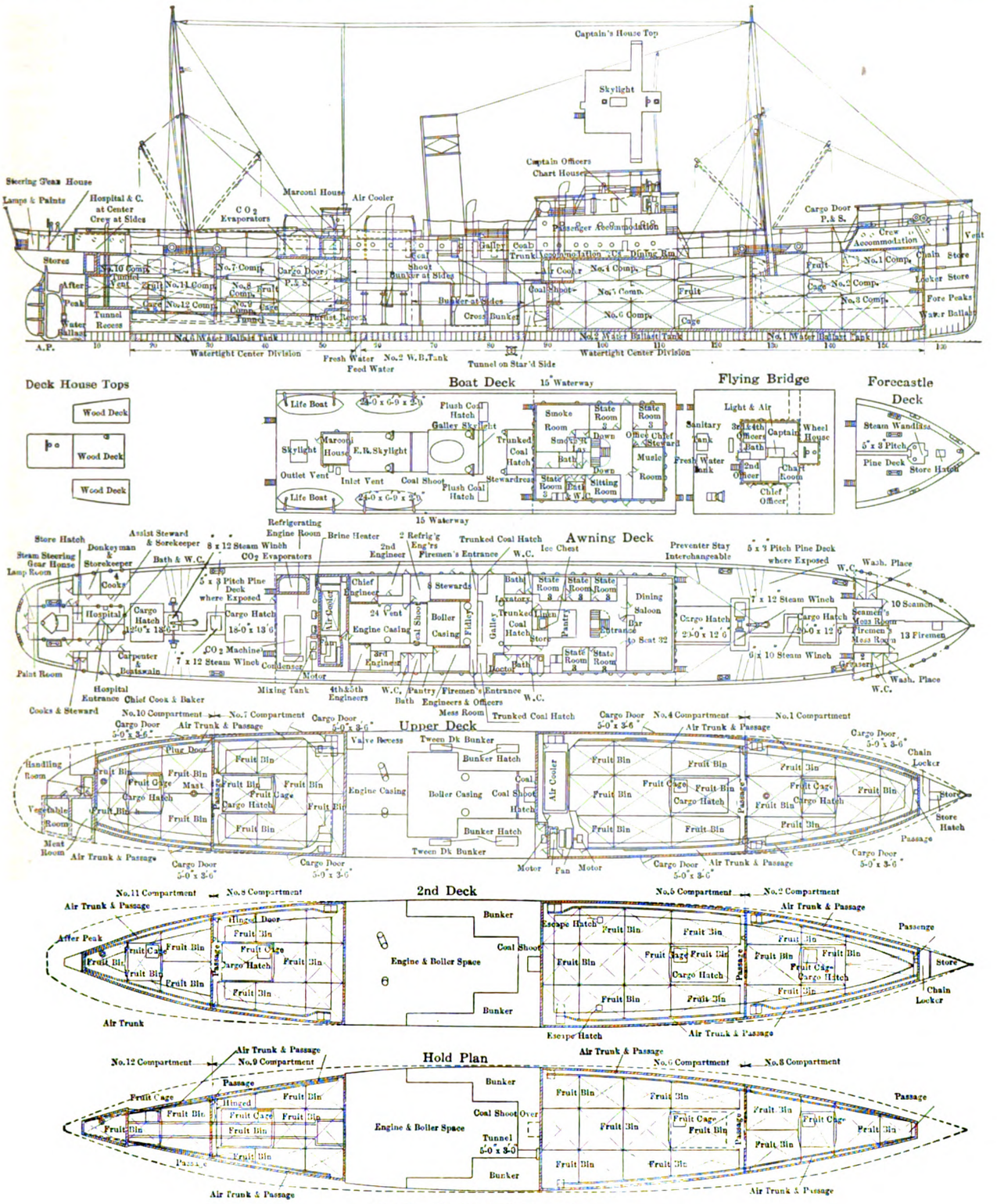

Fig. 3.—Profile and Deck Plans

WIRELESS

The wireless telegraph installations on the *van Hogendorp* and her sister ships will be carried out by the Société Anonyme Internationale de Télégraphie sans Fil, of Brussels. The alternating current necessary for the working

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of each of these sets is supplied by the motor generator. The direct-current motor is directly fed by the ship's dynamo, and is of about 4 horsepower, with a speed of 1,500 revolutions per minute. It is fitted with a suitable starter and field regulating resistance. The alternator has a maximum output of 2 kilowatts and its frequency is 500 and voltage 220.

The switchboard controls the alternating circuit and is fitted with a two-pole switch, a pair of cartridge fuses, a pilot lamp, and ammeter with short circuiting plug and a voltmeter with key. The alternating current is sent through the primary of a step-up transformer, a manipulating key and an adjustable iron core inductance.

The high tension current from the transformer secondary feeds the transmitting condenser, which is made

Fig. 4.—Smoking Room

Fig. 5.—Dining Room

of glass and zinc plates fitted in a lead-lined, oil-tight, teak case. The condenser is discharged through an adjustable multiple spark discharger, which forms, with the primary of the auto jigger and a variable inductance, the primary oscillating circuit. The second oscillating circuit comprises the aerial, aerial tuning inductance, secondary of the auto jigger, one safety spark gap, a hot wire ammeter, and the earth connections. The power used for transmission depends on the number of spark gaps put in circuit, and it is thus easy to adjust the actual range of the station. The voltage of the alternator is regulated in accordance with the number of gaps in use.

The wave lengths in transmission are 300 and 600 meters. The primary oscillating circuit is adjusted to the required wave-length by changing the number of turns of the jigger primary. The adjustment of the secondary circuit is obtained by regulating the number of turns of the jigger secondary and of the aerial tuning inductance. The hot wire ammeter shows whether the two oscillating circuits are well in tune. The variable inductance in the primary oscillating circuit is used for the final adjustment of the two circuits. The aerial and earth leads of the receiving apparatus are connected to two poles of the safety spark gap. During transmission the gap is short-circuited by the spark. During reception the whole current from the aerial goes through the receiving apparatus, so that no changing of connection is needed when sending or receiving.

The main receiving apparatus is a highly sensitive crystal receiver which can be tuned for every wave-length between 250 and 3,000 meters. The apparatus comprises two inductively coupled circuits. The primary circuit is connected between the aerial and the earth. It is composed of an adjustable inductance, a variable condenser, and the primary of the coupling jigger, which is divided into three independent sections capable of being connected in series. The secondary of the jigger, which is also divided into three coils that can be connected by means of a special switch, forms, with a variable condenser, the secondary circuit.

In a parallel with the secondary condenser is connected the detector circuit, composed of the crystal, a potentiometer and the primary winding of a telephone transformer, the secondary of which is connected to the receiving telephone. The crystal is protected by means of a double relay by which it is insulated during transmission. The relay is in series with a couple of dry cells and an auxiliary contact with the manipulating key, which is closed during transmission.

A magnetic detector is provided as emergency receiving apparatus. When the latter detector is used, the aerial tuning inductance and condenser of the crystal receiver are used as tuning device. A special commutator permits of connecting up either crystal or magnetic detector. The earth and aerial terminals of the receiving apparatus being connected to the electrodes of the safety spark gap, no changing over of connections is necessary when sending or receiving.

The earth connections are made of brass bolts screwed direct to the hull of the ship. The aerial is made of 42/23 phosphor bronze cables suspended between the two masts by means of high tension insulators. The down leads are connected to the leading-in insulator, which is fixed through the roof of the wireless cabin.

Emergency Set

In addition to the set described above, there is also an emergency set for use in case of accident to the ship's dynamo. This battery set consists of an induction coil, a manipulating key, a battery of accumulators, and a switchboard. The switchboard comprises a double pole, two-way switch, two single pole one-way switches, a resistance of about 5 ohms, a voltmeter, charging and discharging resistances and fuses. It is possible to work the coil with the current of the ship's dynamo, and it is for that reason that a suitable resistance is fixed on the above-mentioned switchboard for the purpose of reducing to the proper value the voltage of the ship's dynamo. The induction coil can be worked by the current of the battery

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of accumulators, which consists of 12 cells of 96 ampere hours. The cells, of specially compact construction, are fitted in six wooden cases. This set has not been provided for general work, but merely as a standby in the event of the current of the ship's dynamo being interrupted.

The *van Hogendorp* was built to the requirements and under the inspection of Mr. van Helden, the consulting naval architect, and Mr. B. Theil, resident engineer, as representing the owners. Further steamships are on order in Great Britain for this fruit service in order to replace vessels now on charter.

Tank Ship Construction*

BY ROBERT WHITING MORRELL, M. E.

The cargo oil system is so designed that by means of the cargo oil pumps and piping, any tank, port or starboard, can be filled with oil or discharged, or can be filled with sea water or discharged overboard, or any tank can be emptied into any other, on either side; and in some cases, two or more different grades of oil can be handled independently.

The cargo oil pumps are in duplicate, one on either side, capable of pumping from either side. They take steam from the main or donkey boiler (usually they require more steam than a donkey boiler can furnish) and exhaust to the auxiliary steam line. The main steam valve should be fitted with an operating rod controlled from the deck. Each pump is connected to a sea valve located in the pump room. It is desirable to keep the pumps as low as possible, in order to reduce the suction head. The pump room bilges are drained by the oil pumps. There is considerable opportunity for economy by having the main air pump independent from the main engine, so that when in port the oil pumps can exhaust to the main condenser and have the advantage of a good vacuum, the auxiliary condenser usually being inadequate. There is also some question of economy in using compound oil pumps, but the more costly repairs and the varying conditions of steam pressure, discharge pressure, etc., makes the advisability of the compound pumps somewhat doubtful. To a large extent, the oil pumps are used for discharging only, the oil being pumped on board from the shore.

Cargo Oil Piping

The cargo oil piping is of heavy wrought-iron or steel, with screwed flanges faced off and bolt holes drilled. Considering discharging conditions first, we find suction pipes at the bottom of the tanks, running fore and aft, on both sides, leading from the pump room. Near the after end of each tank the suction pipe extends down close to the bottom of the ship, with a flare or bell-mouth and a valve. Two cross-over pipes extend through the centerline between each pair of compartments, so that either compartment connects with either suction line, by means of valves. In order to keep the suction lines low, they should be run through the lightening holes in the transverses, in which case the pipes should be in lengths easily removable. Master valves of the sluice type are fitted at each transverse bulkhead.

Having reached the pumps through the suction lines, the oil is pumped up to the deck through vertical discharge pipes in the pump room. Two of these pipes are necessary in order to handle two different grades of oil simultaneously; and in order for either pump to discharge to either side of the ship, a cross-over connection is necessary between these two pipes. If both pumps are to discharge to either side of the ship, independently, at once, a double cross-over is necessary. The cross-over may be in the pump room or on deck, preferably the latter. Air and drain cocks should be provided in the cross-over. The ends of the cross-over are fitted with Y outlet castings to which the shore hose is attached and which are kept blanked when not in use. Hose davits are located conveniently to these outlets. Lengths of portable pipes are also provided for attaching to the outlets when discharging water ballest, in order to keep the deck free of water. From the discharge pipes at the pump room, one or both pipes are extended aft along the deck to the stern, for use in certain ports where it is necessary to discharge over the stern. Discharge outlets may be provided wherever desired along this stern discharge line.

Filling may be accomplished through the vertical pipes in the pump room, and in addition vertical filling pipes leading to the suction lines are provided where desired, usually one forward and one aft of the pump room, port and starboard. Filling and discharge outlets may be fitted with cross connections or the hose may be led across the deck, whichever is preferred.

It is required that in handling two grades of oil at the same time, the respective pipe lines must be separated by two valves, so that if one valve leaks the grades will not mix. It is also required in ships having the filling and suction pipes of their fuel bunkers attached to the main cargo pipe lines, that the bunker shall be isolated from the cargo oil by removing sections of piping from all cargo lines leading into the bunker and blanking the exposed ends. This is to prevent naptha or other explosive cargo from getting into the fuel space. In order to use the cargo piping for filling or discharging the bunker, the blanks must be removed and the pipes connected up.

The main suction and discharge lines must be fitted with expansion joints. The suction lines are anchored at the transverse bulkheads, and must have an expansion joint in each tank. The deck discharge line is anchored at the deck tees and generally one expansion joint in the line is sufficient. This line has a tendency to work in rough weather, putting a severe strain on the joints. Heavy bracket supports are therefore fitted on the deck to secure the piping, usually with lead liners next to the pipe. These should grip the pipe solidly, but not enough to prevent motion entirely.

The cargo oil piping is carefully tested out at the shipyard when completed, at a pressure anywhere from 150 to 250 pounds per square inch. The piping when under pressure has a tendency to distort, which puts a strain on the flanges. This also should be taken into consideration in designing the support brackets.

A small pipe, usually 2 inches, is tapped into the suction line in each main oil compartment and led to the deck, with a valve. This is for the purpose of blowing through the oil piping, to remove oil or water standing in the pipes, and to clean them out.

Heater Coils

Certain oils are too heavy to be handled by the ship's pumps unless heated. This makes it necessary to fit heater coils in the oil tanks. A steam main leads from the boiler room, with branches and separate cocks for the various tanks. In each tank, the pipe leads to the bottom and extends fore and aft in several sections, about 200 to 300 feet in all. Several lengths are concentrated near the suction. The pipe then leads to the deck where it is advisable to fit a test cock, by the use of which the leakage of any oil into the coils can be detected. The return line then leads to an inspection tank in the engine room, and also to the atmosphere. It is found that the steam does not condense

* Concluded from the January issue.

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in the line, but returns to the tank as steam, which would fill the engine-room if the usual non-watertight cover were used. It is therefore necessary to make the inspection tank entirely watertight, and fit a vapor pipe extending above the top of the engine casing. The inspection tank is piped to the hotwell, through filters, and also to the reserve feed tank in the double bottom. The heater coils should be well secured by hangers, and should be tested out with steam at the yard. This test should be made after all staging has been removed from the tanks, as it is quite possible that a stage-plank may be dropped on the piping and cause a break or a leak.

VALVE OPERATING RODS

The operating rods for the valves in the oil piping inside the tanks form an important item. These may be of solid or hollow section in the tanks, but where they pass through the oiltight deck they must be solid, to prevent oil from leaking up through the deck. Also, where they pass through the stuffing boxes in the oiltight deck they must be perfectly smooth. These stuffing boxes should be of the gland and stud type. Two studs are sufficient, usually, but they must be calked. Stuffing boxes must be kept clear of seams or other riveting in the deck plating. The under side of the flange of the casting resting on the deck must be smooth and a good thick packing used. If the operating rods pass through a coal space, they must have guards to protect them from the coal. The guards consist of two 6-inch by 6-inch angles, toe to toe and extending from deck to deck, being fastened to the deck top and bottom by two clips each. Where the clips come on the oiltight deck they must be packed, calked and through-riveted, not tapped. If riveting is impossible, then the tops must have grommets and nuts under the decks. Clips should not be located over any deck rivets, but if unavoidable, the rivets should be flushed off. The clips should not be so located as to interfere with screwing the nuts on the gland studs. The angles are screwed to their clips by hex head tap-bolts.

Deck brackets have to be fitted at the upper end of the operating rods to support the hand-wheel. The bracket should be of cast iron with brass bushings and should extend at least two feet above the deck. The stuffing box and bracket can be cast in one piece. The hand wheel has no vertical travel, but the rod is usually fited with an indicator to show whether the valve is open or shut. This consists of a short threaded sleeve held from turning, so that it has a vertical travel on the rod. It carries a pointer which travels between spots on the bracket marked "open" and "shut." It is important that the pointer does not foul the gland studs, which would prevent the valve from closing. A fourteen-inch hand wheel is generally used, and all hand wheels should be marked with label plates showing what valves they operate.

If the lead of the rod is straight, it is quite easy to fit, although care must be taken in passing through the deck that it does not bind, due to the camber or sheer of the deck. It sometimes becomes necessary, however, to knuckle the rod, using universal joints. In any case, the rod should be vertical where it passes through the deck. It is not advisable to knuckle a rod at all, and in no case at a greater angle than ten degrees, as the rods bind badly when knuckled. It is considered wise to fit all operating rods with slip-joints, in order that they may adjust themselves to the deformation of the ship when in dry dock.

VAPOR PIPES

The properties of the oil are such that it expands under heat and contracts when cooled, and gives off a vapor gas which also expands and contracts due to changes in temperature. To provide for this, it is necessary to connect the oil tanks with the atmosphere in order that the air and gas can escape when expansion occurs, and that a vacuum will not be formed if the oil contracts. A pipe is led from the top of each tank or from the hatch cover for this purpose. It usually extends about ten feet above the deck to carry the gas off clear of a man's head.

If the ship carries a very heavy oil only, and makes only a short run, or only carries oil from a warm climate to a cold one, it is satisfactory to fit a U at the top of the pipe and cover the open end with wire mesh to prevent sparks from entering. But if the ship carries light volatile oil on a long trip, the loss due to vaporization will be excessive, and it is necessary to fit an automatic valve at the top of the pipe, instead of the U. This valve is designed to lift at about five pounds pressure, in either direction; so that if the oil expands, the air and gas can escape as soon as the pressure reaches five pounds, or if the oil contracts air can enter the tank as soon as the pressure inside is five pounds less than that outside. The valves should be covered with wire gauze and should be examined frequently, as they have a tendency to corrode and stick, which might result in a dangerous pressure in the tanks.

The system works very satisfactorily for ordinary service, but there are certain ports where the law requires that these vapor pipes be carried thirty feet up the mast. In vessels using these ports, the practice is to connect the vapor pipes from all the tanks into two mains, which are carried up the masts so required, and terminate in the automatic valves. This makes all the tanks inter-communicating through these mains, which is undesirable, and therefore a stop-valve is fitted at each tank to shut it off from the main. This again is undesirable, for these valves should be closed when filling, and opened immediately after; and if anybody forgets, it will cause trouble. Also, if the automatic valves should stick, at a height of thirty feet, the pressure would be excessive. Thus the system of carrying the vapor pipes up the masts has many disadvantages, and should not be adopted unless required by the law, the individual vapor pipes for each tank being much more satisfactory.

If the ship burns oil, opinion differs as to whether vapor pipes are necessary from the fuel oil bunkers, but it is certainly safer to have them, unless the run is a very short one. These should be independent of the pipes from the cargo oil tanks.

SHORE STEAM

It is quite common, when docking at refineries to prohibit fires on board the ship. It is therefore necessary to supply steam from the shore, and the ship should be fitted for this purpose. Shore steam is required on the oil pumps, the deck winches, the heater coils, smothering pipes and ship's heating and cooking system, as well as in the engine room for the generators, and auxiliary pumps. Three shore connections should be provided, one for the oil pumps and deck use, one for the heater coils, and one for the engine room.

The deck connection should attach to a main from which the various systems are led. A short vertical pipe with a cross T should be fitted so that the hose may be attached with a straight lead from either side of the ship. A valve should be located on either end of the T, or the valve may be placed in the vertical pipe, in which case the end of the T opposite the hose must be blanked. The connection should not be placed too near a discharge casting or the steam hose will foul and burn the oil hose.

SMOTHERING SYSTEM

The smothering system in a tank ship differs from the

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ordinary in that it has its main stop valve located in the boiler room, and has a separate cock at every tank. These cocks are required to be kept open when at sea. Thus, when the main valve is opened steam is admitted to all the tanks at once, and as soon as the fire is located all the cocks not required can be closed, localizing the steam to the tanks where it is needed.

In a shelter deck vessel, the United States Steamboat Inspectors are likely to require that these cocks be located above the shelter deck, rather than in the 'tween-deck. They also require the main valve and all the cocks to be fitted with label plates.

The smothering system is also used for steaming out the oil tanks for cleaning purposes, and while the smothering outlet is at the top of the tank the pipe should extend down nearly to the bottom of the tank, with a separate cock, for steaming out. The steaming out pipes may be attached to the heater coil system instead of the smothering system, however.

DRAINAGE

In regards to drainage, it is important to note that no scuppers which drain any spaces into which oil might leak should lead into the engine or fire room bilges. In a shelter deck ship, if provided with tonnage openings to exempt the 'tween-deck space from measurement, the upper deck abreast the oil space must have shell scuppers. If without tonnage openings, the shell scuppers in this space should be omitted, except one at the after end, abreast the machinery space, which will not go through the oiltight deck.

Due to the fact that a tank ship will often trim by the stern when light and by the head when loaded, with fuel consumed, it may be advisable to fit a double set of scuppers in some of the quarters aft, one set in the after end and one in the forward end of the compartments, in order to drain in either direction. The shell longitudinals in the oil tanks should have large drain holes.

In some cases it is necessary to run the plumbing scupper or soil pipe from the midship deck house out through the summer tank to the shell. This requires special provision to insure oiltightness inside the tank. The ordinary lead soil pipe above the deck, usually four inch, connects to a cast steel scupper body on the upper deck; and inside the tank a six-inch extra heavy wrought steel pipe, lead lined, is fitted from the upper deck to a cast steel scupper body on the shell. These scupper castings are riveted and calked to the deck and shell, respectively, while at the upper deck the pipe joint bolts are fitted with trunkboard grommets under the heads and nuts. The flanges of the six-inch pipe to the shell scupper are riveted and calked.

The cofferdams should be fitted with suction pipes to the bilge pumps. It is sometimes required to carry water ballast in either or both of the cofferdams, and if so they are piped accordingly. It is also very useful to provide some system whereby any oil which leaks into the cofferdams can be pumped back into the oil tanks instead of being pumped overboard and lost. This can be done by means of the fire and bilge pump, taking the suction from the cofferdam, and discharging into the fire-main. By putting a valve in the fire-main on deck to close it off, an oil hose can be attached to a fire-plug and the oil pumped directly into an oil tank.

No paint whatever is required inside the oil tanks except that all faying surfaces should be coated with red lead and zinc. The oiltight hatches should be painted inside and out, however, after tank-testing has been completed. No painting should be done on the outside of the oil-space, such as the shell and upper deck, until the tanks are tested, if it can be avoided. The weather deck should be covered with an oil preparation, after the hose-test, which is required on a shelter deck vessel.

No cementing is done in the oil tanks, but the bottom of the pump-room and cofferdams should be cemented to facilitate drainage, and the cofferdams are generally cement-washed inside, throughout, provided they are used for ballast and not for fuel oil.

It is usually necessary to provide means of clearing the oil tanks of gas and steam before they can be entered. For this purpose, a fan is located in the pump-room and arranged to draw from the oil suction pipes and discharge into the air. By reversing the connection fresh air can be forced into the tanks through the oil pipes. It is also considered advisable to provide a gas exhauster for the pump-room itself. This can be accomplished by means of the fan, or by a special device consisting of perforated pipes in the pump-room leading to vertical pipes extending up through the deck with a steam jet led into them. A similar device may also be fitted to the deck discharge pipe, to remove gas from the pipe before connecting up for discharging.

Bleeders or docking plugs should be fitted to every main oil tank, also the pump-room and cofferdams. This should be located near the after end of each space. Sounding pipes should be provided for the cofferdams. The amount of oil in the main tanks can be determined in three different ways: first, by having marks put on the vertical metal ladders in the tank, so that the height of oil can be read and the corresponding volume found on the capacity plan; second, by inserting a batten and measuring the height of oil from the top of the tank and again referring to the capacity plan; third, by having a graduation batten in each tank which reads direct the volume of oil for any height. The latter method is decidedly preferable.

Every precaution must be taken against fire. Smoking is generally prohibited, and prominent signs placed to give warning against it in several different languages. No oil lights are used except in emergency; all the running lights are wired for electricity, and even the ruby distress lights should be provided with an electric cable and receptacle on the foremast. A spare generator should be carried so that electric lights can always be used. Lightning conductors are provided on the masts, consisting of a rod at each truck and a length of copper wire leading to the deck through insulators on the backstay; at the deck the wire is coiled on the pin-rail and the end can be thrown overboard in a thunderstorm.

PRICES OF SHIPBUILDING MATERIALS ADVANCED IN JAPAN.—There has been a general advance of 10 to 100 percent in the price of materials for shipbuilding since the last of August. Among the most important are steel plates, zinc, gas pipes, plate glass (thick), asbestos plates and iron wares, each of which has advanced 50 percent: steel bars have increased 70 percent, and lead, tin and plate glass (thin), 100 percent.

JAPANESE TRANSPACIFIC LINE.—Announcement is made in Manila that the Nippon Yusen Kaisha will put three of its new steamers on the Hongkong-Europe run. These three vessels will be the *Ysaka Maru*, *Suwa Maru*, and the *Fushimi Maru*, of which the first named was scheduled to leave Hongkong November 18. These new steamers have a gross tonnage of 12,000 and a displacement of 21,000 tons each. Their cargo capacity is 14,000 tons and their speed 17 knots each. There are accommodations for 122 first class and 60 second class passengers. The vessels are very modern in construction and are well equipped with safety and convenience and comfort devices.

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Dyson Chart System of Propeller Design

Calculation of Total Effective Horsepower—Application of Dyson Chart to Triple Screw Battleship

BY JAMES S. MALSEED

There have appeared at different times in this publication references to the Chart System of Propeller Design by Captain Charles W. Dyson, U. S. N. The writer wishes to show one of the many possibilities that can be accomplished by the use of this system.

When a vessel is moved through the water at a given speed it requires a certain effective horsepower to propel the vessel at this given speed. The propeller must deliver this effective horsepower. The model tank has been used to advantage to determine the necessary effective horsepower, and from the powers found by model tank experiments engineers have fixed the necessary indicated horse-

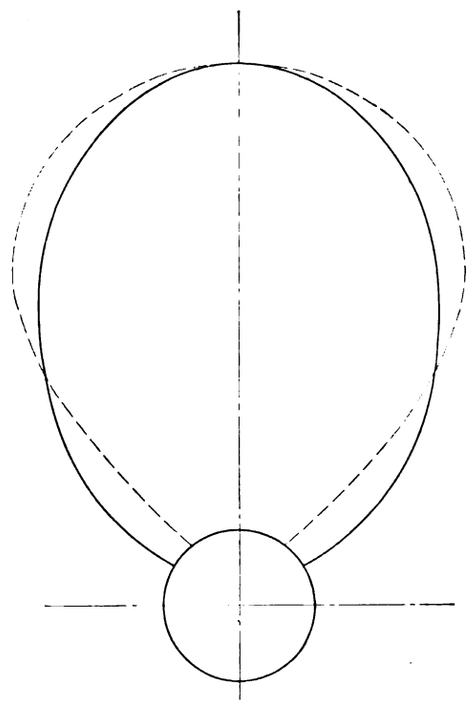

Fig. 1.—Solid Line Shows Actual Blade Form. Dashed Line Shows Dyson Standard Form

power or shaft horsepower to deliver this effective horsepower. I have never heard, however, of any one who would calculate the effective horsepower from the actual indicated horsepower or shaft horsepower determined under actual conditions. With the "Dyson" method this calculation becomes a very simple operation.

Calculation of Effective Horsepower Delivered by the Screw

To calculate the effective horsepower delivered by any given wheel, acting behind a given vessel, it is first necessary to estimate the chart wheel complement of the given screw. The necessary information required is as follows: Diameter, pitch, projected area ratio and the form of the projected area. The characteristics of the vessel are also necessary, such as length between perpendiculars, beam immersed, block coefficient, coefficient of immersed mid area and the shape of the different waterlines of the after body of the vessel. With the above data and a curve of results from a standardization trial of the vessel or the data for any certain speed, the effective horsepower can be calculated for that certain speed or with the curve of performance given, the effective horsepower can be calculated throughout the *whole* range of speeds given.

The estimate of the complementary chart wheel to the given wheel is made by laying down the given wheel to its exact projected area form. Then, through arcs drawn to tenths of the radius, each arc is compared to the "Dyson" standard blade form of projected area and the mean is taken as the projected area of the given screw to use with the charts. In this estimate the outer third of the blade is considered to have twice the influence of the inner two-thirds of the blade.

Applying this projected area ratio, together with the standard block coefficient and thrust deduction factor found on the charts for the given vessel, the pitch and diameter being the pitch and diameter of the given wheel, the different values of indicated horsepower, or shaft horsepower, effective horsepower and speed, are then calculated from the charts for a *chart wheel* working under chart conditions for this particular projected area ratio.

The effective horsepower is then found for any given speed from the formula—

$$dehp = \sqrt[x]{\frac{IHP_d}{IHP \times \left(\frac{v_d}{v}\right)^{3.5\,(1-x)}}} \times DEHP$$

where, $dehp$ = effective horsepower of the vessel,
$DEHP$ = effective horsepower (chart condition),
IHP_d = indicated horsepower from trial result,
IHP = indicated horsepower from chart condition,
v_d = speed of vessel corresponding to IHP_d,
v = speed chart condition.

The exponent x is found from the "Dyson" charts.

It will be noticed from the above that there are three distinct estimates to make, namely, projected area ratio, chart block coefficient and the trust deduction factor, but even with the many chances for error in estimating these values the results obtainable are remarkably close.

Example

As an illustration of how closely the effective horsepower may be calculated, an example is given of a battleship which recently finished her official trials. The vessel has triple screws, 13 feet 6 inches diameter, 10 feet pitch, and an actual projected area ratio of .508. The propellers are three-bladed. As the vessel has three screws, the wing screws must be calculated separately from the center screw and the sum of *twice* one wing and the center is taken as the total for the ship, as the wing and center screws are working under entirely different conditions.

In the example under consideration, the chart block coefficient for the wing screws is .602, while the block coefficient for the center screw is .72, and the thrust deduction factors are 1.012 and 1.082, respectively. The estimate of the complementary chart wheel shows a projected area ratio of .434. This is due to the narrow tipped blade fitted to the wheel.

Fig. 1 shows the difference of the projected area form of the actual wheel fitted and the chart wheel of the same projected area ratio as the actual wheel. The calculations

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for the chart wheel, working under chart conditions, with a projected area ratio of .434, give the following results:

	Wing	Center
SHP	8325	7282
DEHP	5330	4360
Speed-knots	18.172	18.724

Fig. 2 shows the curves of actual shaft horsepower for the wing and center screws plotted separately. It will be noticed that the center-screw curve shows the characteristic hump of a screw working behind a stern port like a single-screw vessel. The curve marked *EHP*, towed model, is the effective horsepower of the ship from the towed model at a constant displacement on even keel. The curve marked estimated *EHP* is from the calculations of the effective horsepower delivered by the screws.

It will be noticed that at the speed of 12 knots the curves of the towed model and the calculated *EHP* exactly coincide. At 15 knots there is a difference, at 19 knots they almost meet, and at 22 knots they separate again. The variations in the calculated curve from the towed model curve prove the correctness and also the usefulness of the calculated curve, for the reason that from the drafts taken on trial the vessel showed 300 tons under the displacement of the towed model at 15 knots and the same condition at 22 knots, while at 19 knots the vessel had 13 tons more displacement than the towed model.

The calculated curve thus shows absolutely the condition under which the vessel was working at the different speeds. The actual difference between the two curves at 19 knots is about 110 *EHP*, while the towed model curve shows a total effective horsepower of 10,900 for this speed. The difference is just about one percent, or as close as the towed model curve itself can be to the actual effective horsepower necessary to drive the vessel at this speed.

This shows conclusively the remarkable work that can be accomplished with the "Dyson" charts.

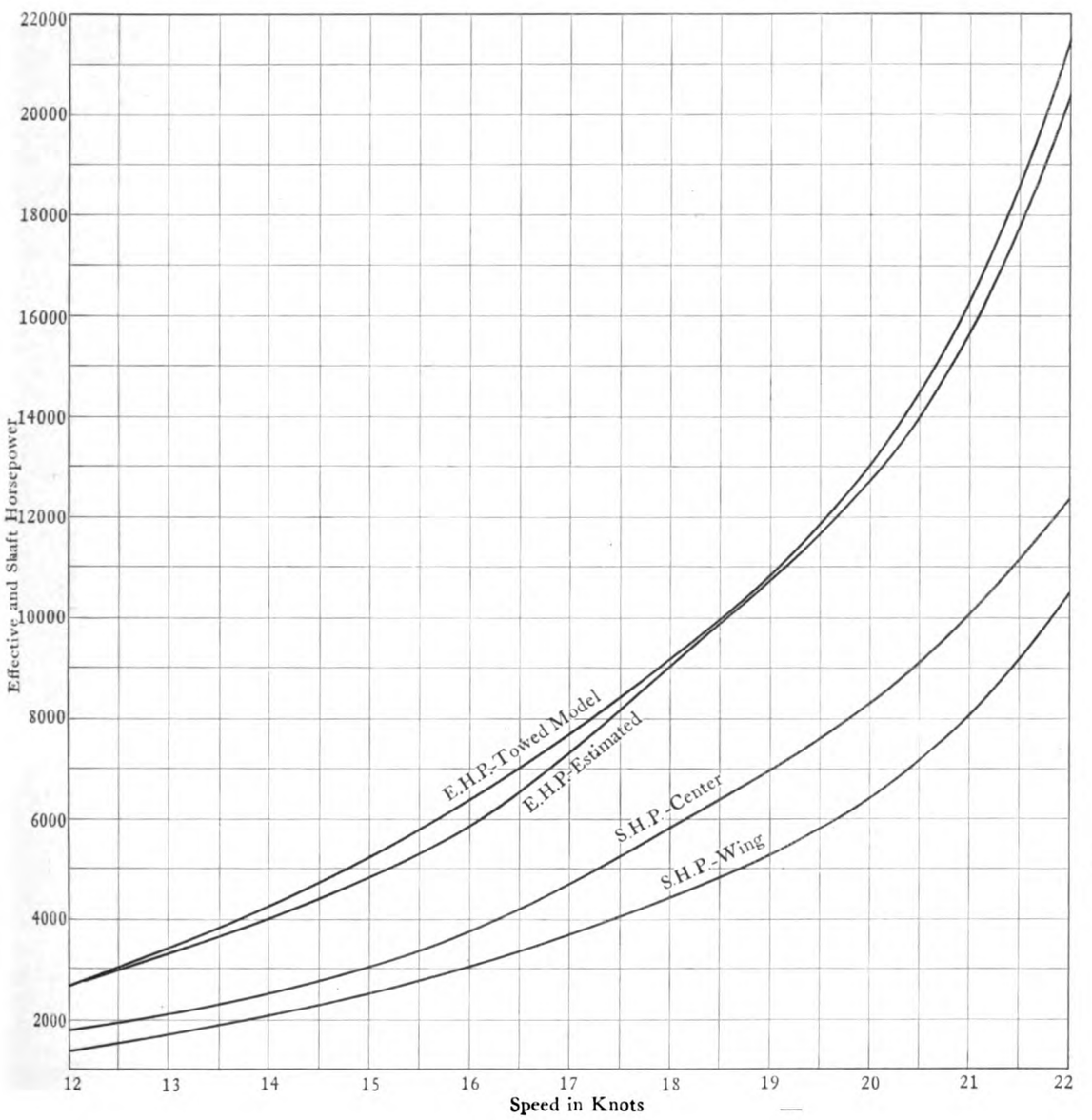

Fig. 2

SUPERIOR SHIPBUILDING COMPANY.—The Superior Shipbuilding Company, Superior, Wis., for twenty years an important factor in the shipbuilding business on the Great Lakes, has given up ship construction and hereafter will devote its attention to repair work.

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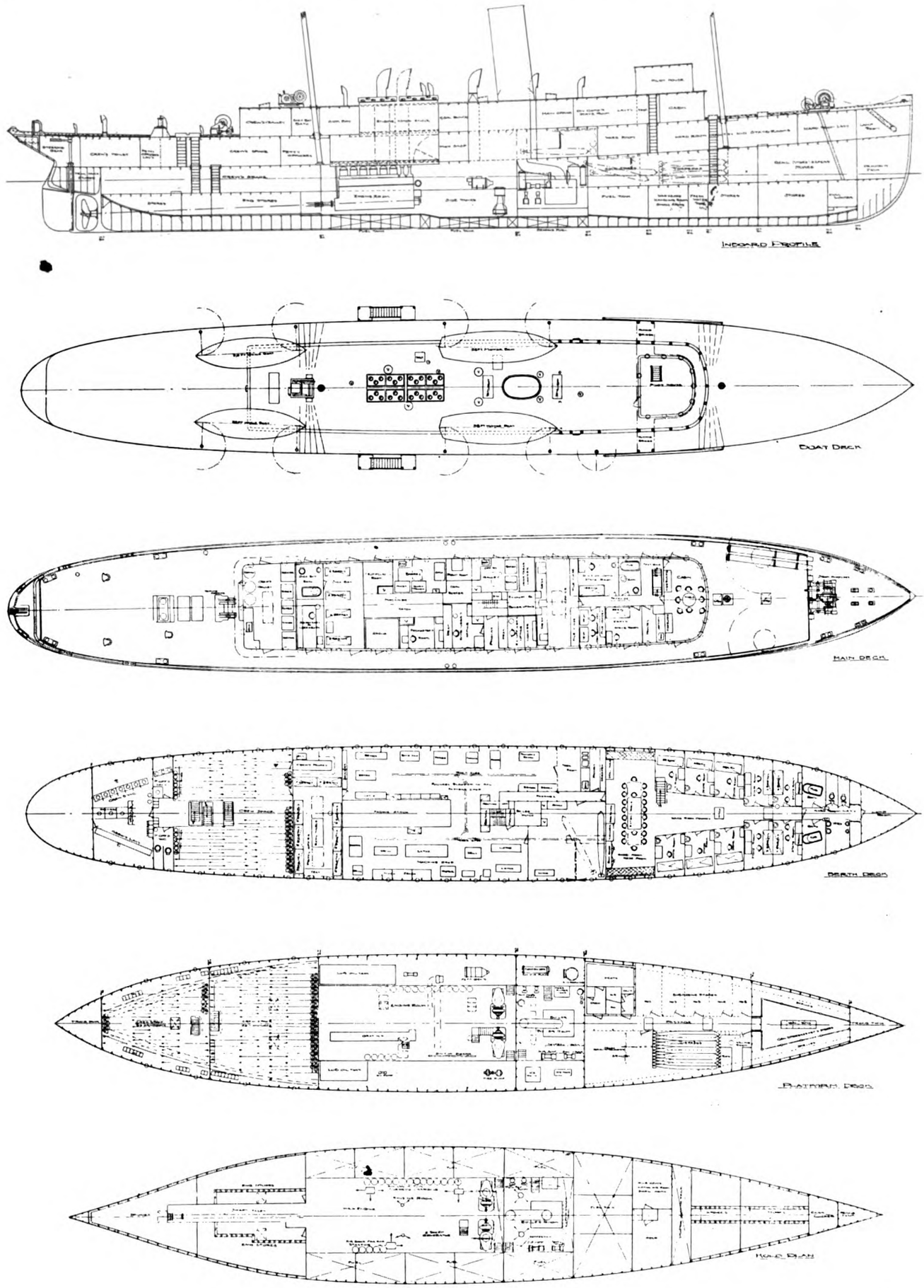

Fig. 1.—Profile and Deck Plans of the *Fulton*

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Trials of the Submarine Tender Fulton

First United States Naval Vessel to be Fitted with Diesel Engines—Contract Speed Exceeded by One-Half Knot

On October 31, 1914, the United States submarine tender *Fulton*, built according to plans developed by the New London Ship & Engine Company, Groton, Conn., working jointly with the firm of Cox & Stevens, naval architects, New York, was given her official tests by the U. S. Naval Board of Inspection and Survey for Ships. The vessel was first standardized over the Provincetown course, five different runs at varying speeds being made. The highest speed attained was 12.78 knots, corresponding to 259.4 revolutions per minute of the propeller. The guaranteed speed was 12.25 knots, thus showing that the ship exceeded her guarantee by one-half knot.

A complete description of the *Fulton* was published on page 285 of our July, 1914, issue, and a description of the shop tests of her main engine on page 510 of our November, 1914, issue. The hull was designed by Cox & Stevens and the machinery by the New London Ship & Engine Company, who built the machinery and sublet the contract for the construction of the hull to the Fore River Shipbuilding Corporation, Quincy, Mass.

The principal dimensions of the vessel are as follows: Length overall, 226 feet 6 inches; length on waterline, 216 feet; beam, molded, 35 feet; depth, molded (to upper deck at center line at one-half length), 24 feet 3 inches; draft, trial load, 12 feet 11½ inches; complement (officers and crew), 190.

The vessel has a complete upper deck, a complete berth deck, platform decks at the end and a double bottom. The general arrangement is shown in the accompanying plans. The main engine is a vertical, inverted, two-cycle, single-acting, air-starting and air-reversing Diesel engine of the Nlseco type. There are six working cylinders and two air compressors, the aggregate power developed being about 1,000 at 260 revolutions per minute.

The standardization trials were followed by anchor tests and maneuvering trials. With the ship running full speed ahead, the signal was sent to the engine room to reverse. The time required to reverse the engine was twelve seconds. The time required to bring the ship to a dead stop in the water was forty-five seconds. Other maneuvering trials, such as the determination of turning circle, maneuvering of helm under various conditions, etc., were also carried out with most satisfactory results.

These trials were followed by a four-hour test at a cruising speed of 11 knots. The object of this test was to determine the amount of fuel used both by the engine and by the boiler, the latter being for auxiliary purposes. The speed made during this trial was 11.09 knots. The boiler used 37.8 gallons of fuel per hour, while the engine used 47.3 gallons per hour. During the test the following auxiliaries were in operation; turbo-generator, electric lights, ventilation, sanitary pump, fuel oil pump, evaporator, fresh water distiller and circulating pumps, ice machine and the pumps for main engine.

On November 1 the eight-hour full power test was made. The guaranteed speed was 12.25 knots. The average speed for the eight hours was 12.35 knots, the average revolutions per minute being 249.49. The average fuel consumption of the engine was 66.72 gallons per hour

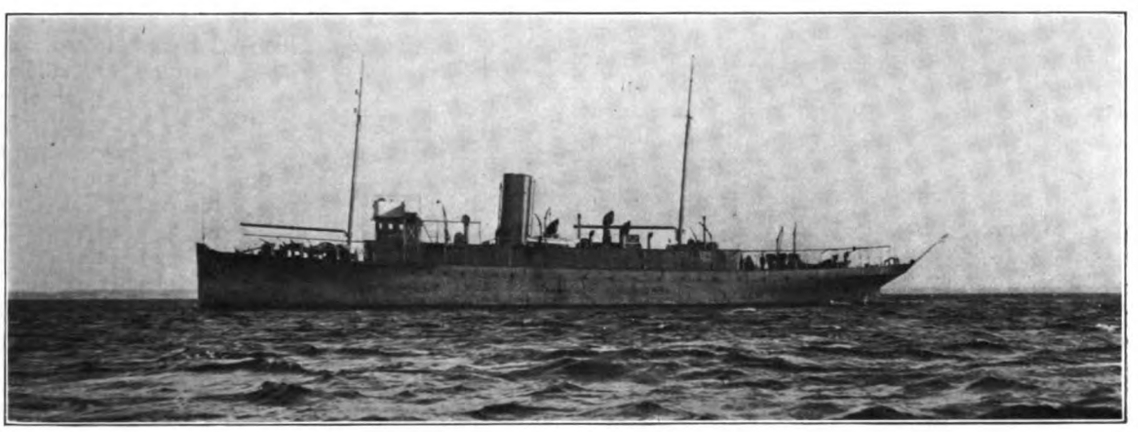

Fig. 2.—Diesel-Engined Submarine Tender *Fulton*

The boiler consumption was 23.31 gallons per hour. Fuel oil was used having a density of 31° Baume.

During all the above-mentioned tests the performance of the engine was said to have been perfect. At no time was the engine shut down, nor was there the slightest evidence of undue heating, unusual noise or other derangement. In view of the fact that this is the first large Diesel engine to be built in the United States and installed in a large ship, the performance is regarded as highly satisfactory.

With the amount of fuel carried in the ship, it would be possible for her to cruise a total distance of at least 10,000 miles. The fuel consumptions above indicated show that as compared with the fuel consumption of a steam vessel the *Fulton*, on a given amount of fuel, could travel four to five times the distance that a similar steam-driven vessel could travel. The saving in fuel bills is obviously a big item. There is also a great saving in the number of men required to operate the machinery. Adding together the saving in fuel, in personnel, and the gain in extra carrying capacity or increased radius, the commercial advantages due to the use of heavy oil engines at once become apparent.

In the *Fulton* the double bottom spaces are utilized to carry fuel oil and reserve feed water. The hold contains fuel oil tanks, storerooms and an ammunition room. On the platform deck are storerooms and a torpedo magazine

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forward and the crew's space aft. Over the engine room on the berth deck is a machine shop, with a torpedo testing room immediately forward. The deck house contains the galleys, bakery, wireless room, sick bay, and various offices.

On account of the peculiar requirements of the service for which the vessel is designed, the outfit of auxiliaries is rather more extensive than is customary. The anchor windlass, steering engine and towing machine require no further notice than to mention that they are of the usual steam-driven types, steam being furnished by a donkey boiler. The electrical equipment consists of two independent installations—a turbo-generator for lighting the ship and furnishing power for auxiliary motors, and two large generators coupled to the main engine, primarily intended for charging the batteries of submarines. The two latter are located on the same fore and aft line as the main engines, and immediately forward of them.

There are also two types of air compressors, two high-pressure compressors driven by electric motors for charging the ship's or submarine's air flasks and torpedoes, and a 100-pound steam-driven compressor for supplying air for pneumatic tools.

The machine shop is equipped with the necessary lathes, drill presses, shapers, milling machines, etc., for making usual routine repairs on submarines. In addition, the foundry and blacksmith shop contain a furnace and a blacksmith and foundry outfit. Cargo ports are arranged through which torpedoes may be passed into or out of the vessel.

New Sea-Going Steel Tug

The steel tug *Bristol,* illustrated in Figs. 1, 2 and 3, was recently designed and built by the Staten Island Shipbuilding Company, Port Richmond, N. Y., for the Staples Transportation Company of New York and Boston for towing coal barges. This is the six hundred and thirty-sixth vessel built by the Staten Island Shipbuilding Company, and is a splendid specimen of the type of towboat for which this firm is noted. The *Bristol* is 125 feet long overall and 120 feet 3 inches long between perpendiculars. She has a molded beam of 24 feet 6 inches and a molded depth of 15 feet 6 inches at the lowest point of sheer.

Fig. 2.—Sea-Going Tug *Bristol*

The hull is of steel throughout with the exception of the pilot house and the captain's quarters, which are of wood. The steel deck house is arranged to provide for the officers' mess and galley, a companionway to the fore-

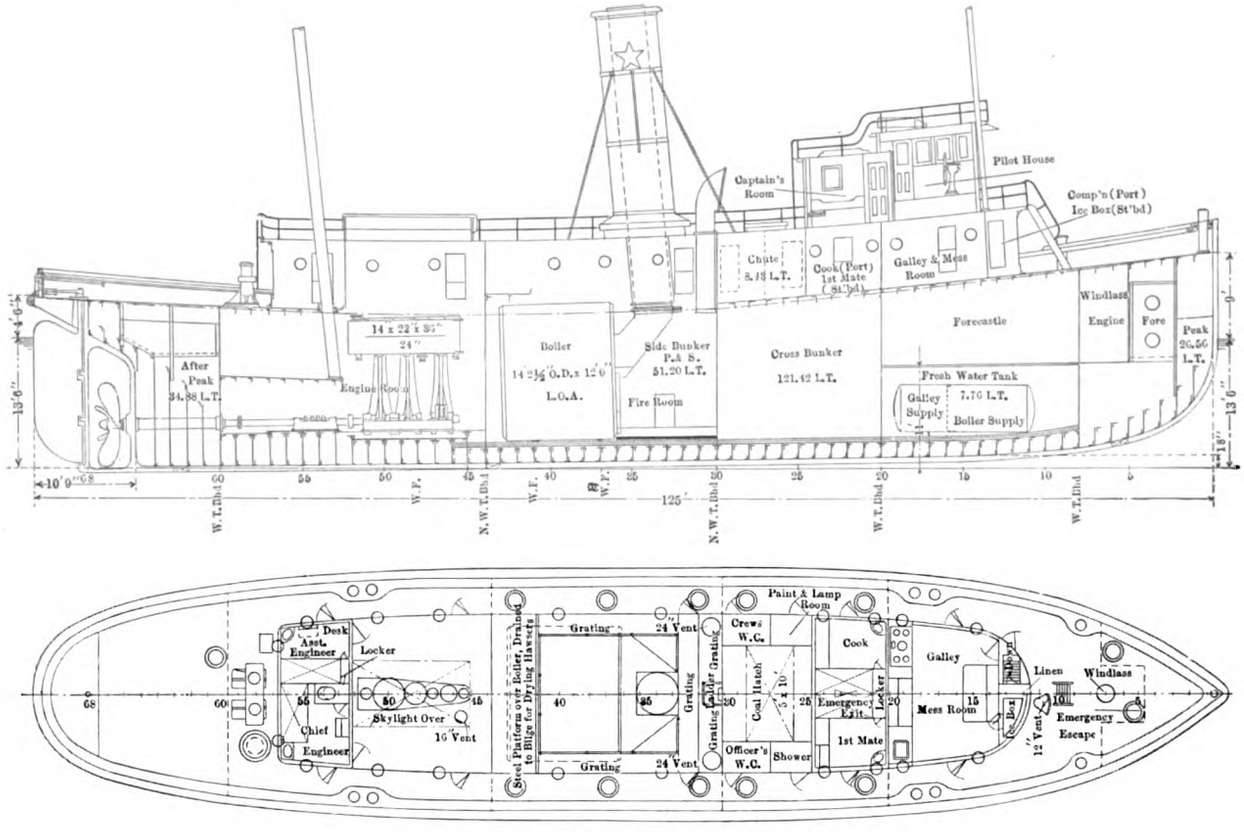

Fig. 1.—Profile and Deck Plan of the *Bristol*

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castle, rooms for the chief and assistant engineer, mate and steward and also for the toilet, lamp and hawser rooms. The crew's quarters are below, forward of the machinery space. Large feed water tanks are provided in the forward and after peaks, with a cross bunker forward of the boiler. The tug is rigged with one wooden pole mast.

The principal scantlings of the hull are shown on the midship section, Fig. 3. There are three watertight bulkheads, one at each end of the boat and one forward of the coal bunker. Two non-watertight bulkheads are fitted, one forward of the engine and one forward of the boiler, the latter forming the athwartship coal bunker. Both of these bulkheads extend to the sides of the ship.

link motion with double bar links. The engine is fitted with a hand-turning gear and a steam reversing gear and exhausts into an independent condenser of circular section with about 1,000 square feet cooling surface. The air pump, made by the Staten Island Shipbuilding Company, is driven off the main engine.

The crank, thrust and propeller shafts are all 8 inches in diameter. The crank shaft is of the built-up type with cast steel webs and wrought steel pins. The propeller shaft is a mild steel forging with composition sleeves shrunk on the shaft.

Steam is supplied at a pressure of 185 pounds per square inch by one Scotch boiler, 14 feet inside diameter and 12 feet long over the heads with a total heating surface of

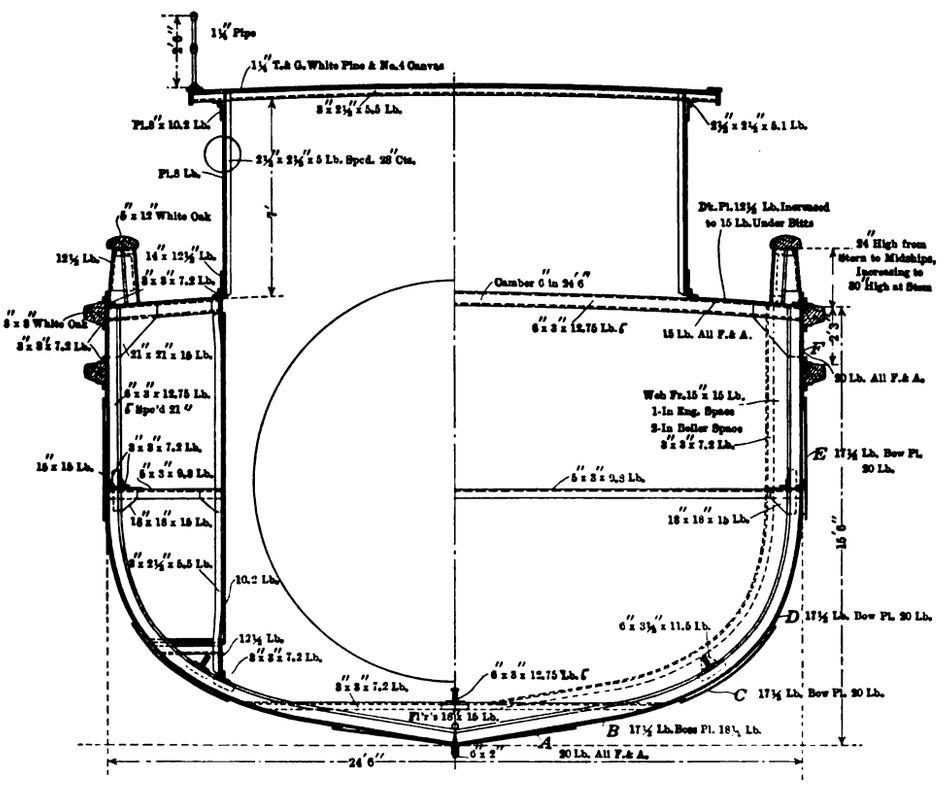

Fig. 2.—Midship Section

The keel is a 6-inch by 2-inch rolled steel bar, fitted in long lengths connected by 20-inch planed scarfs. The stem is of the same size and quality material, while the stern frame is of the best hammered scrap iron in one piece, both the propeller post and rudder post being 6 inches by 3 inches. The frames are 6-inch by 3-inch by 12.75-pound bulb angles spaced 21 inches apart, extending from the keel to the deck. Intermediate ice frames consisting of 5-inch by 3-inch by 9.8-pound angles are fitted from the stem to about 30 feet aft of same, extending from 2 feet below the light-load line to 2 feet above the deep-load line. Two web frames of 15-pound plate 15 inches deep are fitted in the boiler space and one in the engine room.

Propulsion is by a vertical, inverted, direct-acting, triple expansion engine with cylinders 14 inches, 22 inches and 36 inches diameter with a common stroke of 24 inches. The cranks are set at 120 degrees and the sequence of cranks is high-pressure, low-pressure and intermediate. The high and intermediate cylinders are fitted with piston valves and the low-pressure cylinder with a double ported slide valve, all of the valves being worked by Stephenson

about 2,400 square feet and a grate area of about 72 square feet. There are three Morison corrugated furnaces 44¾ inches inside diameter leading into a common combustion chamber. The boiler is operated under natural draft.

The auxiliaries include the usual feed, bilge and sanitary, donkey and boiler circulating pumps. All of the pumps are of the Blake type, with the exception of the air and circulating pumps, which were made by the Staten Island Shipbuilding Company in accordance with their special design. A Reilly feed water heater is installed. The electric current for lighting the vessel is supplied by a Sturtevant machine with a capacity of 5 kilowatts at 110 volts.

The *Bristol* is a first class sea-going tug and is equipped with every modern device for safety and ease of handling in the service for which she was designed. Her bunkers have a capacity of 200 tons of coal and she carries 70 tons of fresh water in her tanks. Captain Ezra N. Hammond is in command of the tug and Herman Kampler is chief engineer.

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Congestion of Freight at New York Piers

Inadequate Facilities and Lack of System Cause Confusion and Wanton Waste of Time in Handling Freight at Marine Terminals

Package freight moves through the New York terminals in quantity and variety greater than through any other terminals in the United States. To cope with this situation, the freight terminals must either be spread over a wide area or else conducted with an efficiency of the highest order. Although the operating area of the New York city terminals can be increased somewhat without even double-decking them, these terminals are quite inelastic so far as area is concerned; therefore that elasticity, which is as essential in operating a terminal successfully as it is in operating any other business, is to be had largely through efficient operation.

spite of this we look in vain for the application of engineers' skill to the improvement of terminals. It is true that valuable suggestions have been made at frquent intervals in different places, but too often these suggestions have found their way into the scrap heap untried. With a few exceptions, freight terminals in New York city and their management remain substantially the same as they were twenty-five years ago. In almost every case they stand, no matter of how recent construction, a monument of the days of manual labor, equipped with meagre appliances of a generation ago, with methods unchanged, charged with the titanic labors that accompany the build-

Congestion Along West Street, New York, in Front of the Steamship Piers

In the New York city terminals under the present conditions, efficiency of the highest order in operation must be had. Anything less must shortly prove intolerable, and as a result commerce will seek routes less choked by which it can move in a fluid state and not in compressed masses. In the movement of package freight through New York terminals, the pre-eminent factor is celerity. Any methods which permit celerity of movement and increase the volume of freight moved in a given time should immediately be installed. To discover a method and to put into operation a plan whereby the business of the freight terminal can be speeded up and the volume of the freight increased is to discover a solution of the terminal problem.

Such a solution must bear a direct relation to transportation as a whole, for the efficiency of any line of transportation in a great measure is limited by the adequacy of the terminal facilities and the speed with which they can be operated. No line of transportation can be more efficient than its terminal facilities permit it to be. In

ing up of one of the greatest commercial centers of the world.

Congestion at the terminals is due in part to the volume of freight moved, but much more to internal confusion in the terminals, resulting from inadequate facilities and lack of system, which cause wanton waste of time both within and without the terminal itself. A freight terminal means the provision for proper contact between the shipper and carrier, and between the carrier and consignee, and thus the duty of a transportation company to provide proper freight terminal facilities is a public one. When the transportation company cannot get sufficient terminal space, then it must improve its terminal methods.

Freight terminals are equipped in some cities with telpherage systems, moving tracks, electric trucks and many other mechanical appliances for the quick handling of freight. Why should not the terminals in the greatest city in America be given equal facilities?

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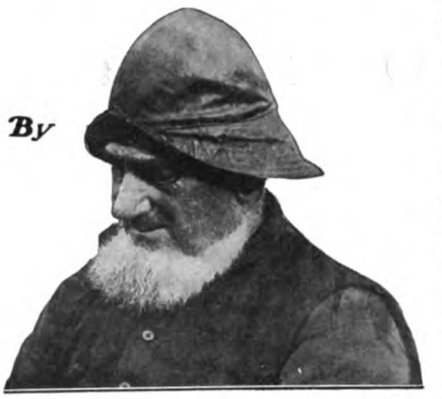
Economy Talks "Old Scotch"

By



Possible Savings with Oil Fuel

In these days when you are looking for economy everywhere, even to cutting down your missionary contributions, it might be a good idea for marine engineers to look into the proposition of burning fuel oil instead of coal. As I said in my first article, most of the economy on ships has got to come from the fireroom, so this oil business offers a pretty good field for saving.

The point where it will pay to switch from coal to oil is not so hard to determine as you might think, and it will depend principally on where you are located whether you should make the change or not. For instance, if you are running out of a port where coal can be purchased for $3.50 (14/7) a ton, and oil costs you $2.25 (9/4½) a barrel, you'd better study how to get the most you can out of your coal, and forget all about oil. Some folks say that three barrels of oil are as good for steaming purposes as one ton of coal, but I don't find it so in my experience with oil burning, and I have had some experience, if I am somewhat over sixteen. As a general proposition you will find that about four barrels of oil are a fair equivalent to one ton of the average coal. Now if you can get oil at $1.25 (5/2½) a barrel and your coal costs you only $4.50 (18/9) a ton, don't be too sure that it will not be economy to use oil, even if four times $1.25 (5/2½) does make $5.00 (1/0/10).

There are other things to be considered beside the exact costs of oil and coal. Remember that with oil you don't need any shovels: a fireman on an oil burner can stand his watch, or even "sit" a watch with a white shirt on and have time to pick his teeth occasionally. No coal to shovel in and no ashes to haul out make the labor part mighty easy, so the result is that you can cut your fireroom force right in half. I know of a steamer converted from coal to oil, on the Pacific, which used to have an engineer's crowd of 36 men that is now getting along with just 19 men, and none of them killing himself with work, either. The reduction of the wages of these men, their grub, cook's wages, etc., amounts to about $850 (£175) a month. That will offset a considerable increase in the cost of oil over coal.

And the saving in wages is not the only one you get from such a change. There will be less repairs to the boilers, no monthly charge for new grate bars, furnace liners, and things of that kind. You will have extra cargo space, as the oil takes up less room than coal; there will be a saving of soap and elbow grease on account of not having to clean up after frequent coalings; a saving in time of fueling and in not having any ashes to dispose of in port or at sea. In fact it is hard to tell all the savings you do get from the use of oil. Anyhow it is a safe bet that it will pay you to use oil, as a general proposition, even if four barrels of that fluid costs you 25 percent more than one ton of coal.

Of course the expense of installing the necessary tanks to carry the oil in is a serious one, and in many cases prevents the use of oil fuel on old vessels. There are a great many old vessels, however, on which a limited stowage capacity of oil can be installed without such a great cost. For example, on harbor boats and on steamers making comparatively short runs between ports, it is only necessary to carry four or five days' supply; as it is an easy matter to take the oil on board the frequency of fueling does not make so much difference. In cases like this, stock tanks can be bought and installed in the coal bunkers at a very small cost. I know of one good-sized tugboat which carries a week's supply of fuel in ordinary hot water tanks such as are made to hitch onto the kitchen stove in a plain $30 (6/5/0) a month brick house. These small tanks were tested to 200 pounds pressure and of course are absolutely oil tight. The cost of the tanks and connecting them up in place was only a little over $400 (£82) so you see that this expense needn't scare anybody off who is satisfied with a limited supply of fuel oil. On this tugboat the cost of the oil pumps, heaters, filters, etc., complete was only $1,200 (£246). That made the total cost of the oil installation a little more than $1,600 (£328). This particular tug is doing business at a port where coal is $5.50 (1/2/11) per ton and oil is 80 cents (3/4) a barrel. The saving in fuel alone compared to what was paid for coal was over $2,000 (£410) the first year the scheme was tried. That's pretty good percentage of saving for a first cost of $1,600 (£328) or so!

I don't know whether many of you have ever bothered to hunt up the right kind of a burner to shoot the oil through. If you have I guess you will come to the same conclusion that I did. That is that the right one isn't made yet. However, almost any of them will work fairly well. I think the Patent Office records will show that there have only been a little over four hundred thousand patents, more or less, issued on oil burners, and that they are running our old friend the car-coupler a close record for the Patent Office handicap.

There are several methods of burning oil on board ship, but practically speaking there are only two used. The greater number of oil-burning vessels are fitted for steam atomization, although there are some fitted for mechanical atomization. The object of both methods is to take fuel oil and shoot it into the furnace in as fine a spray as it is possible to get, something like the way the barber shoots perfume over you just before he puts out his hand for the tip you are about to hand him, after you are all dolled up.

With proper burners, properly handled, oil can be burned without a sign of smoke. When you are looking for economy on your particular ship don't forget to look into the oil question.

Yours for economy,

Old Scotch

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Questions and Answers for Marine Engineers

Inquiries of General Interest Regarding Marine Engineering and Shipbuilding will be Answered in this Department

CONDUCTED BY H. A. EVERETT *

This department is maintained for the service of practical marine engineers, draftsmen and shipbuilders. All inquiries should bear the name and address of the writer. Anonymous communications will not be considered. The identity of the writer, however, will not be disclosed unless the editor is given permission to do so. Indicator cards taken from marine engines will be carefully analyzed, the defects pointed out, and the horsepower calculated, provided complete data are sent with the cards.

Q.—Will you kindly explain the essential difference between reaction and impulse turbines and what is meant by a compound pressure and compound velocity turbine? I. V.

A.—Steam turbines are essentially mechanisms in which the velocity of the jet or jets is utilized to produce rotation of vanes. Velocity is produced in a steam jet only by expanding from one pressure to a lower pressure, so that regardless of the type of turbine there must always be a pressure drop to generate the velocity which is utilized. The velocity imparted to the jet may be utilized in two ways: (1) By impinging on a vane and driving that vane by impulse; or (2) by driving backwards the nozzle in which expansion has taken place owing to the reaction, or "kick-back," of the steam in coming to a high velocity from a low one by expanding through the pressure drop. No. 1 is basic for impulse turbines and No. 2 for reaction turbines. If a large pressure drop is available, this means a high nozzle velocity, and in some cases it is difficult to utilize efficiently a high velocity, so recourse is had to making the pressure drop occur a small amount at a time, each drop in pressure and attendant increase in velocity being but a fraction of the overall drop; this is known as pressure compounding. (See Fig. 2.)

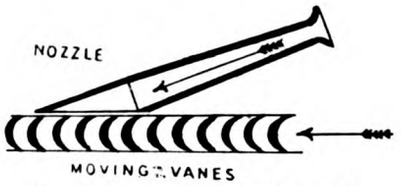

Fig. 1.—Sample Impulse (DeLaval)

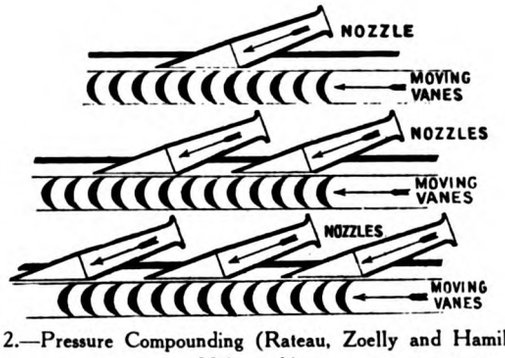

Fig. 2.—Pressure Compounding (Rateau, Zoelly and Hamilton-Holzwarth)

The same result may be obtained by accepting the high velocity due to a large pressure drop and arranging several rows of vanes so that each row takes out a certain fraction of the velocity of the jet; as, for example, if a pressure drop of 150 pounds gives a nozzle velocity of 3,600 feet per second the peripheral velocity of one row of vanes to utilize all of it would be 1,700 feet per second, but if there were four wheels, the velocity of each would be but one-fourth of this, or 425 feet per second. This is called velocity compounding. (See Fig. 3.) Frequently both pressure and velocity compounding occur in one turbine, as, for example, the Curtis type, where the turbine as a

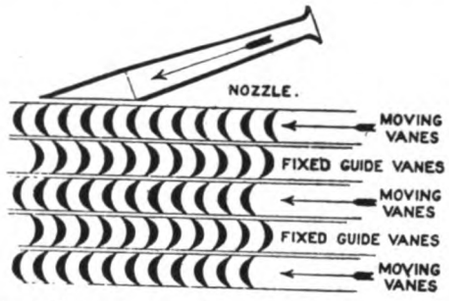

Fig. 3.—Velocity Compounding (A. E. G. (Small), Electra and Terry)

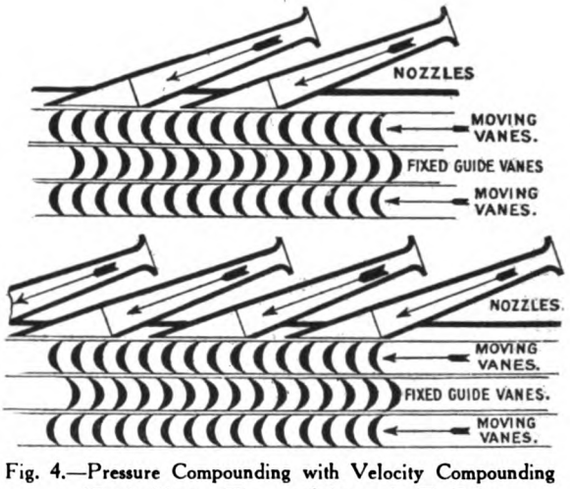

Fig. 4.—Pressure Compounding with Velocity Compounding (Curtis Marine Type and large A. E. G.)

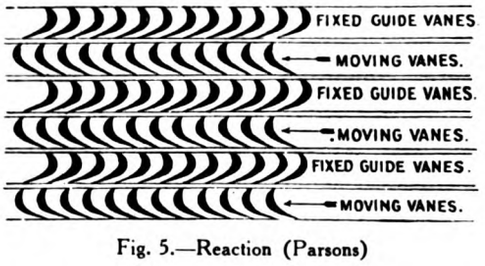

Fig. 5.—Reaction (Parsons)

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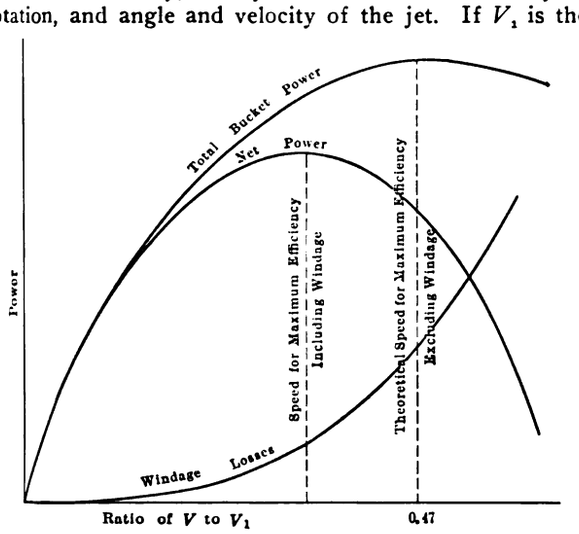
whole is of the compound pressure type with each pressure stage of the compound velocity type. (See Fig. 4.)

There are no turbines of the pure reaction type in common commercial use, but an example is the much illustrated toy of Hero consisting of a sphere with steam under pressure, which is caused to rotate by the reaction, or "kick-back," of two steam jets inserted into it with their discharge axes at right angles to the axis of rotation of the sphere. The turbine most commonly classed as of the reaction type is the Parsons (see Fig. 5), in which there is a small pressure drop in the first row of vanes, the reaction from which tends to cause the vanes to rotate away from the direction of discharge. Though called vanes, these are in effect nozzles, as there is a pressure drop and velocity increase taking place in them. In the next row the same action takes place, but these vanes being fixed, the jet impinges against the following rows of moving vanes which feel the compound effect of this impulse and the reaction due to the further expansion through the second moving row. This cycle is repeated throughout the rest of the turbine.

Q.—In the design of a steam turbine of the impulse type is it possible to calculate the speed of the vanes which will give the best steam economy, or is this desirable speed determined from tests? T.

A.—The speed of rotation of a steam turbine wheel, neglecting friction and windage losses, in order to give maximum efficiency, is only a function of the velocity of rotation, and angle and velocity of the jet. If V_1 is the



Plot Showing How Windage Losses in High-Speed Turbine Wheels Affects Choice of Desirable Peripheral Velocity

absolute velocity of the jet, and V is the velocity of rotation of the vanes and α is the nozzle angle, then the efficiency is the ratio of the work done to the energy delivered by the jet. The work done is the impulse times the distance through which it moves. Work $= \frac{W}{g} V_1 \cos \alpha \times V$, if there is to be no velocity of whirl on leaving the vanes. The kinetic energy of the jet is $\frac{W V_1^2}{2g}$, so that the efficiency is $2 \frac{V}{V_1} \cos \alpha$. If we make the efficiency a maximum of unity then $V = \frac{1}{2} V_1 \cos \alpha$, which is the theoretical vane velocity to give maximum efficiency, neglecting frictional and windage losses. For a nozzle inclined at an angle of 20 deg. to the wheel, $\frac{1}{2} \cos 20$ deg. $= .47$ and $V = .47\ V_1$. In order to further reduce vane speed, more than one row of vanes is frequently utilized in a stage. This reduces the peripheral velocity of the vanes in direct proportion to the number of rows used, so that the factors for V for two, three, or four rows become 24 percent, 16 percent and 12 percent, respectively, of V_1, using 20-degree nozzles. In practice neither the frictional nor the windage losses can be neglected, and for single-wheel turbines, as used on land practice, the windage losses become the dominating feature in the choice of a proper vane speed, as may be seen from the accompanying sketch. In the marine type, however, which uses two or more rows of vanes to each stage and much lower revolutions per minute, the windage losses are a much smaller percentage of the total losses, and the factors given above, when corrected for frictional losses in the vanes, may be used. The correction for friction through the vanes is a geometrical one, and if the loss be expressed in terms of the heat available for producing velocity, and represented by y, the velocity of discharge is equal to

$$V = \sqrt{2\,g\,h\,(1 - y)}.$$

For various values of y the following table* holds:

VANE SPEED IN PERCENTAGE OF JET SPEED

Loss Factor Y	.04	.08	.12	.16
Stage of one wheel	47	46	46	45
Stage of 2 wheels	24	24	23	23
Stage of 3 wheels	16	15	14	13
Stage of 4 wheels	12	11	10	09

* From Steam Turbines, by C. H. Peabody.

Q.—Is there any way for readily determining the helicoidal and projected area from a propeller in place on a ship? H. H.

A.—The best way of obtaining the helicoidal or developed area of a propeller wheel from the propeller itself is to stretch a large piece of ordinary brown manila paper smoothly over the acting surface of one blade and press it down around the edges to get the contour. Trim the paper to this crease and measure the area by taking the breadths at equal intervals and summing by the trapezoidal or Simpson rule. If the former is used, and one breadth is located at the extreme tip, the area is the sum of half the tip and hub breadths plus all the others multiplied by the distance radially between successive breadths. The projected area may readily be determined from the developed area with a reasonable amount of accuracy by either of these two formulæ; the first proposed by S. Barnaby and the second by D. W. Taylor:

(1) $$\text{Projected } A = \frac{\text{Developed Area}}{\sqrt{1 + 0.425 \frac{\text{Pitch}}{\text{Diameter}}}}$$

(2) $$\text{Projected } A = \text{developed } A \left(1.067 - \frac{0.229\ \text{Pitch}}{\text{Diameter}}\right)$$

No. 1 becomes inaccurate if used for pitch ratios (pitch ÷ diameter) and much different from 1.0. No. 2 is expected to hold over a range of pitch ratios from .6 to 2.0, which is all that is customarily met with.

Q.—Are there any simple tests for lubricating oils which the operating marine engineer can undertake which will help him to decide upon the best oil of the many commercial oils presented for his purchase? L. B. C.

A.—It is probably impossible to obtain complete information about any oil outside of a well-equipped laboratory, but there are several important characteristics of the ordinary mineral lubricating oils which can be determined without much apparatus. These are: (1) specific gravity; (2) flash point; (3) gumming; (4) acidity, and (5) adulteration with animal or vegetable oils. A trial of

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these tests will usually permit an engineer to select for himself the best of several samples of oil submitted.

No. 1 is determined by the common Baumé hydrometer directly, as the mineral oils are usually designated by the Baumé scale. (The true specific gravity may be found by the formula $\frac{141.5}{131.5 + B^\circ}$, where B° represents the reading Baumé.) No. 2 can be determined by heating some of the oil in a porcelain dish until a puff of flame goes over the surface of the oil, and by noting the temperature at which this occurs. No. 3 is determined by thoroughly mixing and heating together 5 grams of oil in a cordial glass or wide-mouthed bottle with 11 grams of nitric acid and copper (ordinary nitric acid—1.34 Sp. Gr.—with two pieces No. 15 B. and S. gage copper wire three-quarter inch long, and one hour later two more pieces), and cooling by setting the glass into a basin of water 50 deg. to 60 deg. Fahrenheit. Brownish spots form in the course of two hours, or in case of a bad oil masses form around the edges and gradually cover the whole surface. No. 4 (acidity) can be determined by shaking one-quarter of a test-tubeful of oil with an equal quantity of warm distilled water, let stand and carefully pour off the oil. Test the water with blue litmus paper. No more than a faint reddening is allowable. For No. 5 put about 1 inch of oil into each of two test-tubes, add to one of these two pieces of metallic sodium as large as half a pea, and to the other a similar quantity of caustic soda. Heat the tubes immersed in an oil bath to 445 deg. for light colored oils and 480 deg. for dark colored oils. If animal or vegetable fats are present, they will saponify and rise to the top and solidify to a soapy jelly of greater or less consistency, according to the amount of fatty oil present.

Desirable characteristics for ordinary marine practice are as follows:

Kind of Oil	Gravity Deg. B.	Flash Point Deg. F.
Engine	27-30	410
Gas engine, cylinder	26	509
Cylinder	23-25	525
"	26-28	400-575
Turbine	25-27	355

(See Engine Room Chemistry, A. H. Gill.)

Use the most fluid oil that will stay in place and do the work. The best oil is that which possesses the greatest adhesion to metal surfaces and least cohesion among its own particles, as mineral oils, sperm, and neatsfoot oils, in the order named.

Q.—How much of a reduction in speed will be caused by foulness of bottom? For example, the ship I am on is an American coastwise steamer, running between New York and Southern ports, and is usually docked every six months. We always think there is an appreciable gain in speed after being docked. Is this so? S. S. D.

A.—There is undoubtedly a gain in speed after cleaning a foul bottom. As for the quantitative effect of foulness of bottom there are few data available, for there is no way of standardizing the *amount of foulness*. Moreover, ship bottoms foul at very different rates on different routes, so that *time out from dock* cannot be used as a gage of foulness. Surfaces covered with a fine or medium sand have more than double the frictional resistance of varnished surfaces, and it is probable that if a ship's bottom is very badly covered with barnacles and marine growths, as occasionally happens after long voyages in tropical waters, the frictional resistance will be increased to four or five times that of the clean bottom. This, of course, does not happen in cases like yours, and it would probably be fair to estimate that the increased resistance was about 20 to 30 percent of the clean bottom frictional resistance at the end of the six-months' period. This would correspond to about 10 to 15 percent increase in the *total* resistance or in the power to maintain the speed of the ship with a clean bottom. Measurement of the increased resistance by noting the reduction in speed is an insensitive method, as the power varies about as the cube of the speed. In other words, an increase in resistance of 15 percent would, with the same power at the engines, result in a reduction in speed of but 5 percent, or about one-half knot for a ship whose speed in the clean condition was thirteen knots. If the ship has to maintain a given speed, it will require an increase in power, and therefore coal, of the full 15 percent. It is obvious that the economical interval for a company to operate its ship without docking is one such that the increased coal consumption equals the docking costs.

Q.—What is the maximum economical time for a ship to operate without dry-docking and cleaning? J. P. WHITING.

A.—See foregoing question.

Q.—How are the revolutions of a turbine determined in the design for a marine installation, and how can I estimate approximately the size of rotor for a Curtis turbine, if I know the power needed? C. P. R.

A.—In general the efficiency of a propeller is higher for slow revolutions per minute and the efficiency of a turbine is higher for large revolutions per minute. The desirable peripheral velocity of a turbine is a function of the steam velocity at exit from the nozzles, and therefore the minimum revolutions per minute is governed by the maximum diameter rotor which will go into the space intended for the turbine, as $V_{periph.} = \frac{\pi \times D \times RPM}{60}$. If the steam chest pressure were 250 pounds and the turbine of the Curtis type, the drop to the first stage is usually about one-half, so that, assuming this, there would be about 57 British thermal units available for producing velocity. The velocity V_1 at exit from the nozzles would be approximately $V_1 = 223 \sqrt{57} = 1{,}685$ feet per second. From the table of coefficients given in a previous question it is apparent that the peripheral velocity V should be about 10 percent of V_1 for a 4-wheel unit, such as is customary for the first stage; therefore $V = 168.5$ feet per second, and if we can have a diameter of casing of 11 feet with about 10 feet for the diameter of the rotor, the revolutions per minute would be $168.5 = \frac{\pi \times 10 \times RPM}{60}$, revolutions per minute = 332.

The problem may be approached from the other side by accepting the revolutions per minute for the propeller as high as can be used without undue departure from good efficiency and then making the rotor as small as this permits.

Q.—One of my engineers has been talking to me of a preparation in which he is interested which is intended to harden copper. It is supposed to be handed down from prehistoric times, or to be derived from analysis of the old hard bronze implements. Is there anything in it? Q.

A.—Probably not. The description has the earmarks of a common catch-penny scheme, especially the mysterious powder and the "hard as steel" part. There are several commercial bronzes on the market now, the major element of which is copper and which can truly be called as hard as steel. Tobin bronze (about 60 percent), for instance, is rolled every day to give ultimate tensile strength 66,000 pounds per square inch, ultimate compression strength 180,000 pounds per square inch, elongation 25 percent, and good wrought steel has 58,000, 150,000 and 25 percent for the same functions.

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Letters from Marine Engineers

Discussion of the Design and Handling of Marine Engines, Boilers and Auxiliaries — Breakdowns at Sea and Repairs

This department is open to all readers of the magazine for the discussion of affairs in the engine room. All letters published are paid for at regular rates. Your ideas or experiences will be mutually helpful and interesting to other engineers. Write your letter now.

The Use of Silver Nitrate

The use of silver nitrate as a testing agent for determining the pressence or the absence of salt in water on board ship is quite common throughout the world. It is only proper that this should be the case, for this is the simplest and best purely qualitative test for certain purposes (notably for testing supposedly fresh water from the distilling apparatus) that has been devised. This is not a quantitative test to any marked degree, but by means of it, it is possible to get a general idea as to whether there is a great deal or only a small amount of salt in the water under test. It is my purpose to give a little general information regarding this material, both from a chemical standpoint and from experience on board ship.

Silver nitrate ($AgNO_3$) is obtained on the market as a nearly white crystalline substance. It is very expensive (costing at least fifty cents (2/1) per ounce under the best of conditions), and therefore should be treated with great care and with a view toward economy. When prepared for use on board ship these crystals must be dissolved in distilled water so as to form a colorless solution. The silver nitrate will dissolve in its own weight of water, but such a solution would be needlessly strong and much too expensive for frequent use. A solution of from 2 to 3 percent silver nitrate (by weight) should be amply strong for any use on board ship. With such a solution only one drop should be necessary to give a satisfactory test. From experience, I have found it practically impossible to persuade men to use such a small quantity as a drop, so as to prevent needless waste of valuable material, I always make the solution much weaker, say 1 percent of $AgNO_3$. If the man making the test pours in several drops of this weaker solution there will have been expended only the same amount of silver nitrate that would have been used if one or two drops of the more concentrated solution had been dropped in.

The general tendency of the men who usually make this test is to believe that quantity plays a large part in the reaction obtained. On this account I have repeatedly seen a man pour in about a teaspoonful of nitrate solution and, failing to get a reaction, but being somewhat suspicious, then pour in about as much a second time. If one drop of the silver nitrate solution is dropped into the water it should give a sharp local reaction if much salt is present, and should show a white, cloudy appearance for even a trace of salt. A general realization of this fact would save a good deal of valuable material.

In preparing a silver nitrate solution aboard ship, great care should always be taken to prevent the loss of the whole lot of crystals to be used. In several cases I have seen this happen on account of careless work in preparing the solution. Since water on board ship always stands a good chance of being contaminated with salt, only two or three small crystals of silver nitrate and a small amount of water should be taken at first. If, after the crystals are dissolved, the solution is perfectly clear, the water may be considered of sufficient purity to be used for dissolving the whole lot. The testing solution may then be prepared with this water. On the other hand, if the first small solution shows cloudiness on account of a fine white precipitate, the water used is not of sufficient purity to use for the whole solution, and a better water must be obtained. Water for preparing the testing solution must not be used unless it fails entirely to give a reaction when tested with another solution or when tested with a few crystals, as described above.

The principal impurity of sea water is common salt (sodium chloride, NaCl), of which it contains approximately 2.75 percent. It is this salt that is immediately shown up by the silver nitrate, even when it is present in very small quantities. When the testing solution is added the following reaction takes place if any salt is present in the water:

$AgNO_3$	+	NaCl	=	AgCl	+	$NaNO_3$
Silver nitrate.		Sodium chloride.		Silver chloride.		Sodium nitrate.

The silver chloride comes down as a white precipitate, practically insoluble in water; the sodium nitrate remains in solution in the water. As a matter of information it might be well to add that the white precipitate is quite insoluble in any ordinary acid solution, but is very soluble if the solution should be made at all ammoniacal.

The usual custom seems to be to keep the silver nitrate solution in a clear, glass bottle, but this should not be the case. The testing solution should always be kept in a dark bottle (brown, black, etc.) so as to exclude the light, because silver salts are readily darkened by too much light. This is the reason that the precipitate obtained on test (AgCl) will readily darken if left exposed to the light for any length of time.

Silver nitrate solution should always be added with a medicine dropper, both to save time and material. Care should be taken to keep it from getting on the hands, as it will cause black spots wherever it is allowed to remain very long. These spots are removed from the skin with considerable difficulty.

If the silver nitrate test is used properly and carefully it will be found to be a very satisfactory test for certain purposes. Of course, this test could never be satisfactory for testing boiler water, as it will always give a reaction with such water. What is wanted in such a case is a quantitative test, not a qualitative one. The silver nitrate test is principally one for determining whether or not the water under test is free from salt—not how much salt it contains.

W. W. B.

Propeller Blade Layout

In the following article the writer assumes that the reader has had some experience in laying out propellers; therefore only references will be made to the various authorities from which the formulæ, data, etc., are taken; it being further assumed that any one sufficiently interested in the subject would prefer to consult the given authorities. The propeller in the illustration has been taken from a turbine-driven torpedo-boat destroyer not using reduction gearing. The small diameter of the propeller is necessitated by the high number of revolutions at which the propeller turns, and this, with the large area

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being confined to the small diameter, is the cause of the extreme fullness of the blade.

In laying out propeller blades in the drafting room the necessary data and information required for the draftsman to proceed with the delineation are obtained by calculations made either by the draftsman or by the computing division. A treatise by Captain C. W. Dyson, U. S. N., on "Screw Propellers," Volume I, Text, and Volume II, Atlas, will be used in making the necessary calculations and for obtaining the shape of blade.

The necessary data obtained from the calculations are the pitch, diameter of screw, number of blades, and the projected area. The projected area will be used as the basis in starting the layout of blade; the shape or form of contour of the projected blade area is taken from Captain Dyson's Chart No. 8, Sheet 24, Volume II, Atlas, from which the corresponding blade of $\frac{PA}{DA}$ ratio is taken.

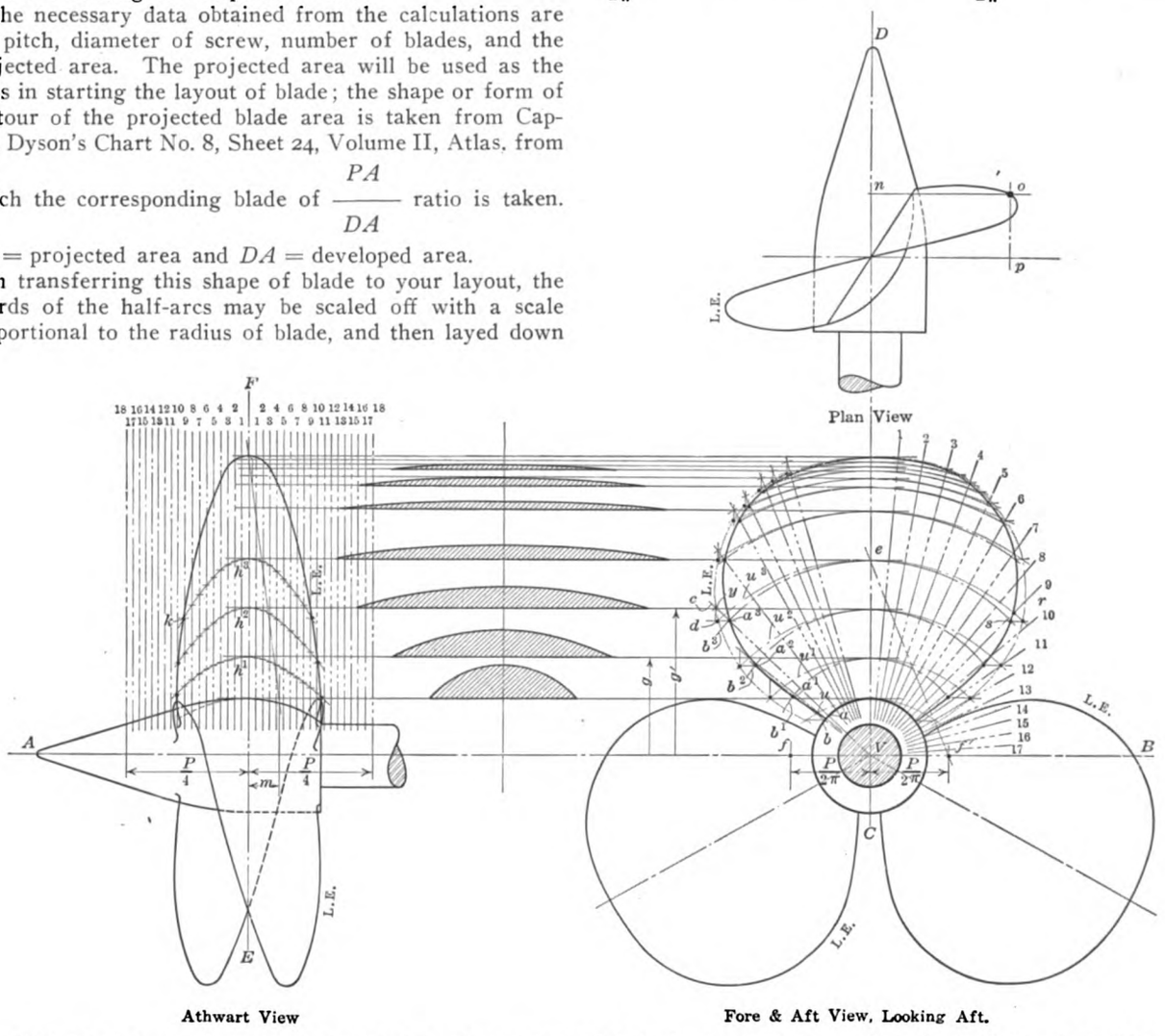
PA = projected area and DA = developed area.

In transferring this shape of blade to your layout, the chords of the half-arcs may be scaled off with a scale proportional to the radius of blade, and then layed down to the new proportions on the fore-and-aft view of the blade desired. These arcs, on which the half-chords are measured, are at tenth units of the radius on Chart No. 8. Of course, you could choose any unit of radius, in measuring the half-chords in transferring the shape of blade, or the shape could be transferred by another method, viz., draw radial lines from the center of the hub, as V-1, V-2, etc., in the illustration, and then scale the distance from V to the contour of the blade with a scale proportional to the radius of blade desired.

After having the contour of the projected area of the blade drawn in, as shown on the drawing in the fore-and-aft view in heavy line, take a planimeter and check the projected area to see whether there is any appreciable error. Now draw in the different circular arcs, as b^1, b^2, b^3, etc., taken at even dimensions from the hub out to the tip, with radii g, g^1, etc. The outermost division at the tip is subdivided as often as is necessary in order to obtain as many points in the flat contour of the blade at the tip as is desired for the correct contour of the developed blade.

In proceeding to draw in the contour of the helicoidal or developed area, locate the two foci f and f^1, whose distance from the center of hub, on the horizontal axis, is $\frac{P}{2\pi}$; the derivation of the term $\frac{P}{2\pi}$ can be found in most books of authorities on screw propellers. Points a^1, a^2, a^3, in the contour of the projected blade are to be found in the developed contour. For example, take point a^3 and draw a line from the center of the hub through point a^3 as line V-c. Now take the distance from focal point f^1 to the intersection of the vertical axis C-D, with the circular arc b^3; with f^1-e as a radius, and V as a center, cut the line V-c with an arc. Draw a vertical line through the intersection and produce a horizontal line from a^3 to the left d, the intersection of the two lines just drawn is a point in the developed contour.

The circular arcs b^1, b^2, b^3, etc., are parts of the minor axis circles of the different ellipses taken at different distances out on the blade. Points a^1, a^2, a^3, etc., in the projected contour, are always found on the minor axis circles. Points in the developed contour, as d, etc., are always found on the ellipses. f and f^1 are foci for all the



Right-Hand Screw: Diameter, 6 Feet ¾ Inch; Pitch, 5 Feet ½ Inch; P. A., 18.52 Square Feet; Ratio P A to D A, 0.64

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different ellipses, therefore distance f^1-e is the radius of the major axis circle of the ellipse a^3. The ellipses u, u^1, u^2, etc., can be drawn by any approximately correct short method having major and minor axes given. It is considered sufficiently accurate, as they are used only in stepping off the width of the sections of the blade. After having established enough points to form the contour of the developed blade, draw a smooth line through them. This completes the fore-and-aft view of the blade, the remaining two blades of the propeller can be drawn in by any correct method of transfer from the blade just drawn.

In order to draw the contour of the projected area in the athwart view of the propeller, we take in the fore-and-aft view the right angle DVB, which is one-fourth of the disk, or one-fourth of the pitch or generating helix, and divide it by radial lines into 18 equal parts of 5 degrees each, namely, 1, 2, 3, etc.

In the athwart view we take a distance on each side of the vertical axis F-E, equal to $\frac{P}{4}$, and divide this distance into 18 equal parts, the same number that we have in the fore-and-aft view between D-B, because one-half of this view of the blade takes one-fourth part of the generating helix, which is the distance $\frac{P}{4}$. Now draw the parallel vertical lines to the right and left of the axis F-E, as 1, 2, 3, 4, etc., respectively, projecting the points of intersection of the projected contour, with the circular arcs. For example, take the circular arc b^2 at the intersection with the projected contour at point s. This point is located about one-quarter of the distance between radial lines marked 9 and 10. Projecting this point s horizontally across to the athwart view, placing it one-quarter of the distance between vertical lines 9 and 10, point k will be a point in the contour of the blade in the athwart view. After establishing enough points to form one-half of the contour of the blade, draw a fair curve through them and complete the other half of the blade by transfer. Point s, it will be noticed, is located on the contour of the following half of the blade, when projected to the athwart view, k will be likewise located in the contour of the following half of blade, which is on the left of center line E-F. The two remaining blades can be drawn in by the same method; but care must be taken, to be sure, that the proper edge of the blade is projected in relation to its location. In the drawing the leading edge is marked L-E.

By projecting the points of intersection of the circular arcs b^1, b^2, b^3, etc., in the fore-and-aft view, with radial lines 1, 2, 3, 4, etc., over onto corresponding 1, 2, 3, 4, etc., vertical parallel lines in the athwart view; and after drawing a fair curve through these points of intersection we will have produced the different helical curves, as h^1, h^2, h^3, etc., at the different distances out on the blade, as g, g^1, etc. However, these helical curves have no practical value in making the propeller; they are, therefore, omitted on all modern drawings of propellers.

The plan view of the blade is invariably omitted on modern drawings, as it in no way aids the pattern-maker or the foundryman in the making of the propeller, but just for drawing purposes, the method for obtaining points in the contour of the blade will be given. Any point in the projected contour in the fore-and-aft view can be taken. For example, we will take r. Take the horizontal distance from r to the vertical axis D-C and lay it down on the plan views as n-o. Point r falls on the radial line 9, so in the athwart view take the distance from the vertical axis F-E to the vertical line 9, and lay it down in the plan view as p-o. The intersection of p-o and n-o at o is a point in the contour of the blade in the plan view.

In calculating the thickness of the blade the formulæ used are taken from D. W. Taylor's book on "Resistance of Ships." In the athwart view dimension m, thickness of blade at the hub, is, in most cases, the only thickness to be calculated, the blade being considered to be a beam fixed at one end only, and uniformly loaded. The back edge is a parabolic curve; but in most cases a straight line from the hub thickness m to the vertical axis at tip, as shown, allows sufficient metal. Just enough metal is added at the tip to take care of corrosion and curling over of the edge.

The dimensions of the hubs of propellers are based on the diameter of the shaft, and previous hubs are always referred to in determining the design, with a point in view of standardizing as much as possible to take care of any isolated cases of interchangeability, but primarily to have a standard design for different classes of vessels.

The sections of the blade shown between the fore-and-aft and athwart views are easily drawn. The length of the sections at the different diameters out on the blade are obtained by stepping off the length on the elliptical curve corresponding to the respective diameter at which it is taken and layed down on a horizontal base line. Lay off the thickness at the center of the blade from the athwart view, which shows the different thicknesses of blade from the root on out in dot and dash lines. Then draw in the shape of the back of the blade with any convenient radius which will allow sufficient metal at the edge. The edge is filled in with a very small radius.

Washington, D. C. HAROLD M. ADAMS,
Draftsman, Bureau of Steam Engineering, Navy Department.

Refloating the Steamship Zeeland by Compressed Air

Scientific methods are rapidly revolutionizing salvage practices. Mere horsepower and the tensile strength of hawsers are no longer the determining factors in getting a stranded ship afloat. True, tugging energy and lines are still valuable adjuncts, but other facilities are playing a big part in winning success. Possibly there is no more striking example of this new era in salvage work than that recently offered in the refloating of the steamship *Zeeland* of the International Navigation Company.

Early last November, this vessel of nearly 12,000 tons, was bound up the St. Lawrence from England to receive an important cargo for a speedy return voyage. During thick weather the *Zeeland* got out of the channel and went ashore at a point between Montreal and Quebec while running at pretty good speed. In fact, she hit the mud so hard that she landed about 36 inches above her light load line and had very little cargo in her which could be removed to lighten her. It was of the utmost importance that the vessel be refloated with all possible speed, and the underwriters believed the quickest solution would be that of dredging a channel for the ship back to the regular course of traffic. This was done, including the removal of the mud from both sides of the ship. This, however, left the *Zeeland* still resting upon a bank immediately beneath her which could not be reached by the dredges. It was found impossible to break the suction between the craft's bottom and the mud by direct pull and the working of her own engine did not help matters. The *Zeeland* was held held hard and fast.

At this point the salvors proposed to cut the rivets of some of the bottom plates from within the ship and to drop

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these after compressed air had been used to charge the overlying ballast tanks and neighboring compartments, the idea being that the escaping excess air working its way upward through the openings so made would break the hydrostatic seal and free the craft. Theoretically the proposal was all right, but the practical drawback lay in the fact that the *Zeeland* would have to be docked on reaching Montreal for the purpose of replacing the detached plates. Only a few days remained before the St. Lawrence would close by reason of ice, and there was the risk of the ship being caught and prevented from making the urgently desired run to England.

The well-known salvage expert Mr. W. W. Wotherspoon was present on the *Zeeland* representing the concern that had rented an air compressor and some other fittings to the contract salvors. He was asked for advice and the refloating of the ship was sublet to him on a basis of no pay if unsuccessful, and just three days were given him in which to solve a problem which had staggered the people already on the job. Mr. Wotherspoon was opposed to the detaching of some of the bottom plates and the application of compressed air in the manner already suggested. He was quite willing to use compressed air but he determined upon a more ingenious and less hampering application of it.

Like most large steel vessels, the *Zeeland* had a double row of composition drainage plugs screwed into the plating of her bottom. These were intended to be removed from outside, whenever the ship were docked and this manner of draining the bilge, etc., was deemed desirable. Mr. Wotherspoon decided to remove fourteen of these at seven different positions along the vessel's bottom, and to this end he had his men tap a couple of holes in the inboard ends of these screw plugs. It was a simple matter then to work them out-board by means of key wrenches. With this done, the threaded ends of flexible pipe connections were screwed into the holes and the attached rubber hose led to the salvage air compressor.

Prior to this, a wire hawser passing around the ship's stem had its two ends secured to the winches aboard the two dredges, one on each side of the *Zeeland,* which were anchored in addition to having their spuds lowered deep in the mud. Ten big sea-going tugs, pulling in tandem, were connected by five lines to the stern of the steamship. With the water removed from her ballast tanks, and everything in readiness, then the air jets were started, while the *Zeeland's* engines of more than 12,000 horsepower joined in the efforts of the tugs and the powerful winches of the dredges. Inside of ten minutes from the turning on of the air, the hydrostatic seal was broken and the liner hauled out into the regular channel, and a few moments later was bound for Montreal under her own steam.

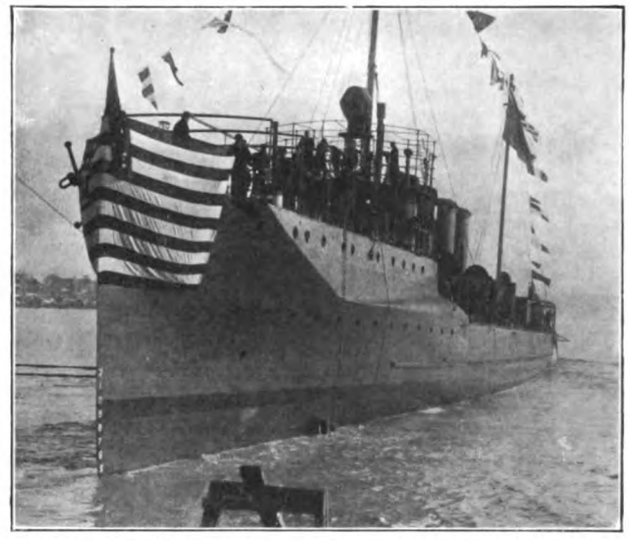
With the ship thus released, Mr. Wotherspoon had his men break the pipe connections, and in place of the original drainage plugs screw bolts were substituted from inside the ship, which effectually sealed the holes. This was a matter of but a few minutes' work, and there was no necessity for the *Zeeland* going into drydock before loading for England. As it turned out, she took on her cargo and cleared from the St. Lawrence some days before ice put a stop to further traffic. Mr. Wotherspoon gives credit to the United States Army Engineers for the inspiration which made this performance possible. It seems that water instead of compressed air was similarly employed in breaking the seal between the mud and the bottom of the vessel when the wreck of the old battleship *Maine* was refloated from the bed of the Havana Harbor. In this case, however, he chose compressed air because he could more certainly count upon its forceful upward trend to break the grip of the suction. R. G. SKERRETT.

Launch of the U. S. Destroyer

The United States torpedo boat destroyer *Cushing* was launched January 16 at the yards of the Fore River Shipbuilding Corporation, Quincy, Mass., and christened by Miss Marie L. Cushing, of Fredonia, New York, the daughter of Lieutenant-Commander Cushing, in whose honor the vessel has been named.

The *Cushing* is one of a class of six destroyers authorized by Congress in 1912. She is 305 feet 3 inches long, 31 feet beam, 18 feet 3 inches depth, and has a displacement of 1,050 tons on a mean draft of 9 feet 5½ inches. She is of the usual torpedo boat destroyer design with a high forecastle, the model for which has been practically standardized by the Navy Department for this type of vessel.

The hull is built entirely of steel, and is divided by watertight and oiltight bulkheads into fourteen principal watertight compartments. All of the strength members of the hull are of a special high tensile steel, which increases the strength of the vessel by about 33 percent.



Destroyer *Cushing* Launched; 85 Percent Complete

Her fuel oil tanks have a capacity of about 93,000 gallons of fuel oil.

The armament of the *Cushing* consists of four 4-inch rapid fire guns and four twin torpedo tubes. In view of the strenuous life experienced during maneuvers and in warfare by the officers and crew of vessels of this type, special attention has been paid to the living spaces, and very comfortable quarters are provided for 6 officers, 8 petty officers and 86 men.

The propelling machinery consists of two sets of Curtis turbines in combination with cruising turbines and reduction gears capable of driving the vessel at a speed of 29 knots. Steam is supplied at a working pressure of 265 pounds per square inch by four oil-fired watertube boilers of the Yarrow-Fore River type placed in two watertight compartments.

OBITUARY.—Charles Ward, founder of the Charles Ward Engineering Works, Charleston, W. Va., died from pneumonia on Jauary 17. Mr. Ward took an active part in his general business until a few days before he died, as he was at the works on January 7 and 8 during the launching of the steamer *Inspector.* Mr. Ward has long been prominent in the marine affairs of this country, having specialized in the building of shallow draft river boats and safety watertube boilers.

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Marine Articles in the Engineering Press

Geared Turbines for Ship Propulsion—Description of the Largest Ship Fitted with Geared Turbines—Improving Boiler Efficiency

Sixteenth Principal Meeting of the Ship Technical Society.—The article states that, owing to the war, one day was set for the meeting and only three papers were read. The first of these dealt with "Fish Steamers and Deep Sea Fishing," describing the types of deep-sea fishing steamers, the methods of operation with the necessary implements and the equipment of the vessels. Statistics were added, not only of German-built fish steamers, but also of English, French and Scandinavian fishing vessels. The discussion of this first paper is stated to have brought out a good many interesting points upon trim, stability, seaworthiness and motive power of fishing steamers. The second paper, on "Oscillations of Ships and Their Influence on Stability," dealt with the uncertainty of calculation of the period and curves of oscillation, as compared with actually observed cases. The discussion pointed out the desirability of model experiments. The third and last paper, on "Efforts Toward Simplification of Steam-engine Construction," is stated to have been a description of an engine of interchangeable parts. 2,680 words.—*Schiffbau,* December 9.

The New American Battleships.—By Morris Prendergast. The main particulars are given of the American battleships of the *Nevada, Pennsylvania* and *California* classes. The whole seven ships in these three classes, although differing in size and other details, are designed to form a tactically homogeneous group. They possess the same speed, turning circles and arcs of fire for the main guns, so that they may act in unison. In appearance they are very similar, each ship having one funnel and two of the typical American lattice-work masts. In the *California* class, an overhanging bow of the Japanese type has been introduced for increased seaworthiness. The principal improvements in the *California* class are extended internal protection, slight increase in armor thickness and the extension of the forecastle deck level to form a higher central position for the 5-inch guns. Little reference is made to the engineering features of these vessels, except to note the introduction of electrical propulsion on the *California.* The main points considered are the armor and armament of the ships. 1 illustration. 2,400 words.—*The Shipbuilder,* December.

The New Cunard Geared Turbine Liner Transylvania.—A fully illustrated detailed description of the twin screw geared turbine passenger and cargo steamer *Transylvania,* recently built by the Scotts Shipbuilding & Engineering Company, Ltd., Greenock, for the Cunard Line. The vessel is 567 feet long overall, 66 feet 3 inches molded breadth and 45 feet molded depth to shelter deck. The gross tonnage is 14,315 and the displacement at a draft of 27 feet 6 inches, 19,400 tons. The total deadweight capacity at the above draft is 8,700 tons and the speed on service 15 knots. Accommodations are provided for 305 first class, 216 second class and 1,858 third class passengers. The vessel is classed 100 A-1 Lloyd's shelter deck. In all there are eight decks, five of which extend over the full length of the ship. The hull is subdivided into fourteen main transverse watertight compartments by thirteen watertight bulkheads. Special reference is made to the construction details and riveting. The passenger accommodation is all situated above the lower deck, the spaces beneath that deck being devoted to cargo and to ship's stores, machinery and coal bunkers. The main turbines and propellers were designed for 1,500 and 120 revolutions per minute, respectively, the ratio of reduction of the gearing being 12½ to 1. There is a high and low-pressure ahead Parsons turbine of the reaction type for each propeller shaft. The maximum power without the use of the bypass valves is 9,500 shaft horsepower and the steam consumption of the turbines is 11½ pounds per shaft horsepower per hour. At full speed on trial the turbines ran at 1,630 revolutions per minute and the propellers at 130 revolutions per minute. Steam is supplied at 210 pounds pressure by six double-ended Scotch boilers, 16 feet in diameter and 12 feet long, working under natural draft. The boilers are arranged in groups of three in two boiler rooms. 9 illustrations. 2,600 words.—*The Shipbuilder,* January.

Geared Turbines for Ship Propulsion.—By W. D. McLaren and G. M. Welsh. Outline particulars of the machinery for a number of typical vessels are given. In each case particulars and estimated performances for machinery of the ordinary type have been first prepared, and similar particulars of geared turbines suitable for each vessel have been computed for comparison. In making the comparison between the performance of geared turbines and other types of machinery consideration is given to the thermodynamical and mechanical efficiencies of the prime mover, and to the propeller efficiencies in the respective types. The method which has been adopted to give this means of comparison is as follows: The resistance of each vessel has been estimated and a curve of E. H. P. plotted on a speed basis and then curves of T. H. P., D. H. P., S. H. P. and I. H. P. have been built up. The consumption of steam has been estimated in each case, and also the boiler evaporative efficiencies for the conditions chosen. From these estimates, values have been found for the coal consumption per 100 miles and all the results have been plotted in diagram form. In all, twelve typical vessels were chosen. It was found in all the cases considered, with the exception of a high-speed liner fitted with high-pressure, intermediate-pressure and low-pressure turbines direct coupled to propeller shafts supplied with steam from cylindrical boilers with forced draft, that the geared turbines show at full power an advantage of coal consumption over the reciprocating or direct-driven type of machinery. The amount of gain in ecenomy depends on the type of ship considered and the curves indicate how this gain is influenced by reduction from the full power condition of running. Attention is drawn to the fact that in comparison with reciprocating engines the reduction in coal consumption becomes unappreciable at low powers and that at some speeds considered the reciprocating engine proved the more economical. Attention is also directed to the manner in which the gain is influenced by propeller efficiency as apart from the thermodynamical efficiency of the prime movers. From the point of view of commercial efficiency, the questions of cost and space occupied by the plant must be taken into account. While the former consideration is outside the scope of this paper, nevertheless, in respect to the latter, some idea can be formed of the saving in boiler room space that may be effected in most cases by the installation of geared turbines. 23 illustrations. 6,500 words.—*Transactions of the Institutions of Engineers and Shipbuilders in Scotland,* November.

How the Efficiency of the Scotch Boiler can be Improved.—By John Tait. As the weak point in the Scotch boiler is commonly agreed to be its defective circulation,

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the author came to the conclusion that the trouble could be overcome in a very simple manner by converting a small portion of the hottest part of the furnace into what is practically a saddle boiler, which would draw its supply from the bottom of the boiler. Working models of this arrangement were made and tested, and seemed to give excellent results. Some objections, however, were raised, one being that it would pocket steam with disastrous consequences to the furnace, and another that it would bring up mud and deposit it on the crown of the furnace. These objections, however, did not seem to be sustained in practice. Another point was brought out, namely, that it is a fallacy to suppose that the circulation in the Scotch boiler is good above the line of fire, and could not be greatly improved. There are two distinct phases in the circulation of water in the boiler. First, that due to the varying density of the water as it is being heated. These currents, which are very feeble at low temperatures, grow stronger as the boiling point is reached, but even at their best are poor compared with what takes place when the second stage is reached and ebullition commences. It is, therefore, to the circulation caused by ebullition that one must look for the rapid motion of water over the heating surfaces so necessary for efficiency. As a matter of fact, the lower surfaces in the Scotch boiler are simply feed heaters, and therefore poorly circulated, which accounts for it not having a greater efficiency. While improved circulation at the top of the boiler does not necessarily improve the circulation at the bottom, it is equally true that the ebullition which takes place at the bottom improves the circulation generally. In other words, the lower heating surfaces are, from a circulating point of view, the most important. The ideal condition of a steam generator is reached when there is a rapid flow of water over all its heating surfaces. The next step in improving the efficiency of the boiler is the manner of introducing the feed water so that the action of the circulator and the natural circulation of the boiler are interfered with as little as possible. The feed water difficulty is overcome by having an internal feed pipe, one end of which goes down to the bottom of the boiler, or any place which may be desired, the other end finishing with a bend near the surface of the water and horizontal to it. Into this pipe the feed is led at any convenient point and is directed through a nozzle in such a manner as to draw a continuous stream from the bottom of the boiler. This water, mixing with the colder feed water, brings it so nearly to the temperature of the boiler that the tendency for the feed water to sink is almost eliminated. The combined flow issuing from the mouth of the pipe at a considerable velocity is further mixed with the hot water in the boiler and absorbs sufficient steam in crossing the boiler to bring it up to almost the steaming temperature. The author claims that by increasing the circulation in the bottom of the boiler and supplying the feed in such a manner that it does not come into contact with the heating surfaces, the maximum of circulation is not only obtained over the furnaces, but this in turn improves the whole circulation of the boiler, the efficiency of the boiler is increased and the cost of repairs greatly reduced. 3 illustrations. 3,600 words.—*Transactions of the Institution of Engineers and Shipbuilders in Scotland,* November.

The Twin Screw Passenger and Cargo Steamers Missanabie and Metagama.—The sister ships *Missanabie* and *Metagama* are the largest vessels so far constructed by Messrs. Barclay, Curle & Company at Whiteinch. They were built for the Canadian Pacific Railway Company for service between Liverpool and Canada. They are 520 feet long overall, 64 feet molded breadth, 41 feet molded depth to shelter deck and have a displacement of about 18,000 tons, a gross tonnage of 12,469 tons and a net tonnage of 7,727 tons each. The cargo capacity is about 400,000 cubic feet and the speed on service 16 knots. Accommodations are provided for 520 cabin passengers, 1,200 third class passengers and a crew of 300. The hull is subdivided by seven steel decks, five of which extend over the full length of the ship, and ten transverse bulkheads, three of which extend to the lower promenade deck, four to the shelter deck, one to the upper deck and two to the main deck. This subdivision provides that any three compartments can be open to the sea and flotability still insured. The vessels are classed 100 A-1 Lloyds. All available space below the main deck, outside of the engine and boiler rooms and coal bunkers, is devoted to the carriage of cargo with the exception of the space required for the ship's provisions and stores. Three of the lower 'tween decks are fitted for the carriage of refrigerated merchandise and have been effectively insulated. The entire space on the main deck and upward is devoted to passenger accommodation. Heating and ventilation is on the dual system, which represents an entirely new departure, and consists of two distinct methods whereby every space on board is assured a sufficiency of heat and fresh air. The cargo handling appliances are very complete, three derricks and two powerful winches being fitted to each hatch, while in addition there is a lattice-girder heavy derrick capable of dealing with 25-ton lifts. An efficient fire-indicating extinguishing apparatus is fitted. The life-saving equipment consists of thirty-two boats, one of which is a motor boat. The majority of boats are stowed in nests of two or three on the boat deck. In most cases the Welin "Planet" system of slewing gear is provided to each set of davits, while at one station where the boats are housed right across the deck the davit gear is of the Babcock & Wilcox type. The electric plant consists of three 100-volt Siemens dynamos running at 1,050 revolutions per minute, coupled to De Laval turbines run at 15,000 revolutions per minute. Each set is capable of giving 100 kilowatts continuously and any two can supply sufficient power for all of the lights and motors in the vessel. Electricity is used exclusively for driving engine room auxiliaries, ventilation fans, motors, galley machinery, etc. In the stokeholds, four Howden forced draft fans are each driven by a 21 brake horsepower motor. For the ventilation system there are eight thermotank motors, each of about 4 brake horsepower, and also ten cased fans of various sizes for the ventilation of the galleys and passenger accommodations. In the crow's nest a Siemens 24-inch searchlight projector is fitted. An emergency generator set is placed on the boat deck, which was supplied by Messrs. John I. Thornycroft & Co., Ltd. The motor is of the Thornycroft six-cylinder type, using kerosene (paraffin) fuel, and is capable of developing up to a maximum of 66 brake horsepower. The generator is of 40 kilowatts capacity. Propulsion is by twin screws driven by quadruple expansion engines with cylinders 26, 37½, 53½ and 77 inches diameter with a stroke of 51 inches. Steam is supplied by eight Scotch boilers, 15 feet 9 inches diameter by 11 feet 9 inches long. The boilers work under Howden's hot air system of forced draft and have been constructed for a steam pressure of 2115 pounds per square inch. A detailed description is given of both main and auxiliary machinery. While the engines were designed for a speed of 16 knots on service, on the trial trip the *Missanabie* developed a speed of 17½ knots. 25 illustrations. 5 plates. 4,825 words.—*The Shipbuilder,* December, 1914, and January 1915.

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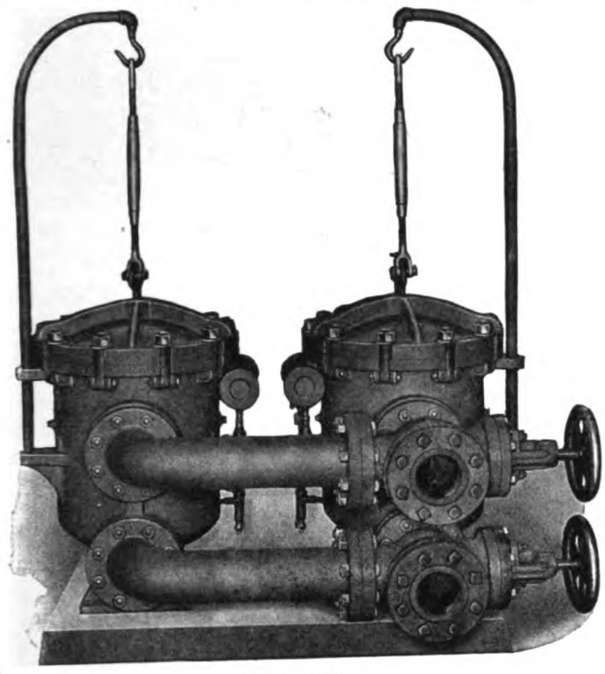
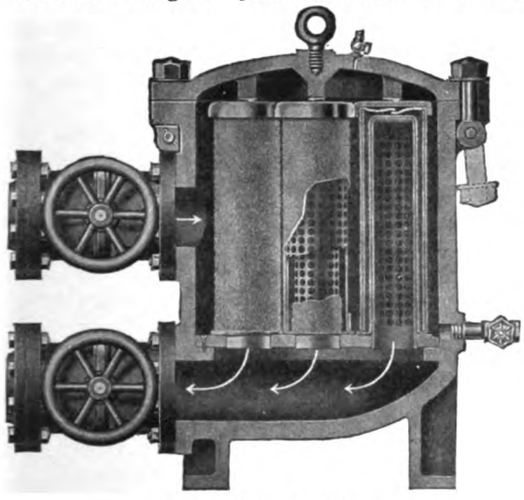
ENGINEERING SPECIALTIES

The Blackburn-Smith Twin Filter

The ever increasing number of plants which carry loads varying greatly at different times, or which operate twenty-four hours per day, has necessitated the design of a filter which would have considerable flexibility as to capacity, and which would permit of the cleaning of one part while the other is in operation. It is readily seen that if a filter of this type is selected of such size that either side alone can carry the regular load, then the two sides can be thrown in during the peak load, thus permitting the thorough filtration of all the water at all times, and without interference by the necessary cleanings.



Twin Filter



Section Through Filter

In the new type of Blackburn-Smith feed water filter and grease extractor having twin bodies controlled by a single set of inlet and outlet valves, which is now being built by James Beggs & Co., 38 Warren St., New York, N. Y., the turning of both valves to one limit by-passes the corresponding body, and the other body is by-passed by turning both valves to the other limit, thus permitting the alternate operation and cleaning of either side. The combined operation of both sides, as would be desirable during the peak load, is accomplished by turning the valves to mid position.

The filter is made up of a number of parts, so that breakage or disarrangement of any particular section does not necessitate the discontinuance of all filter service, and as these machines are tested to 400 pounds hydrostatic test pressure before shipment, the probability of such interruption of service from defective material or workmanship is unlikely. The valves are of the double seat type and the disk working between the seats is self-seating, thus preventing leakage due to dirt deposited on either disk or seat.

The filter chests are the same as in the single type of Blackburn-Smith filter—each divided into an inlet and an outlet chamber by a partition carrying the filtering cartridges. Each cartridge consists of two concentric perforated brass cylinders so covered with linen terry cloth that two uniform separated and successive filtering surfaces are put into the path of all entering water. The opening of the filter for cleaning is facilitated by the use of a large cover held by swing bolts. A crane and turnbuckle lift swings and holds the cover during cleaning with a minimum of labor.

A Suction Lubricator

A new and novel lubricator, made in three sizes for ¾-inch, 1-inch and 1½-inch pipe connections, for use particularly on devices operated by compressed air, has just been placed on the market by the Vulcan Engineering Sales Company, Chicago, Ill.

The principle involved is one of suction. A chamber containing an absorbent is kept saturated from another large oil storage chamber surrounding it. Air passing through the lubricator becomes sufficiently charged with oil to properly lubricate all surfaces with which it subsequently comes in contact.

This device is entirely automatic, because suction action takes place the instant the air moves and ceases the instant the air is shut off, and the take up of oil is very moderate, though continuous when air is being used. It can be attached to the air line in any position and operate in any plane or at any angle, and can be filled no matter what position it is in. It is therefore universal and foolproof.

Hanna Suction Lubricator

It is claimed the suction lubricator will prolong the life of pneumatic equipment and greatly conserve the amount of lubricant used, thereby increasing efficiency and reducing maintenance costs.

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New Steamship Regulation, Effective January 1, 1915

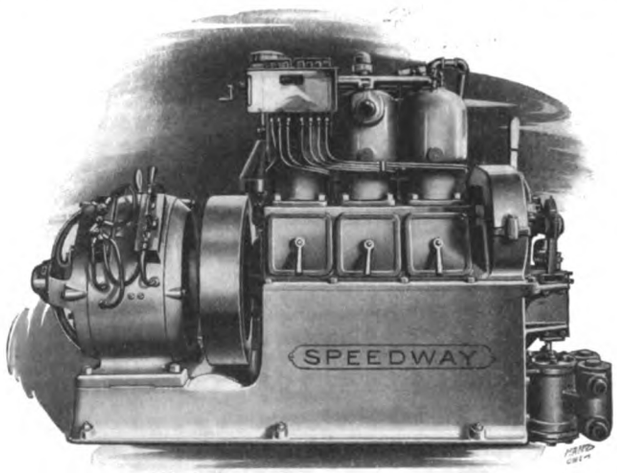
At a recent session of the Board of Supervising Inspectors an important regulation was adopted as Section 16, Rule IX, General Rules and Regulations for Ocean and Coastwise Vessels. This regulation reads as follows:

"On and after January 1, 1915, all steamers carrying passengers subject to the inspection of this service, which are provided with a plant for electric lighting purposes, the dynamos of which plant are located below the deep load line, shall have on board an auxiliary plant located above the deep load line, capable of thoroughly lighting the vessel in case of an emergency."

This regulation also applies to steamers navigating on lakes, bays, sounds and rivers.

In order that gasoline (petrol) generating sets may be used—as this system is entirely independent of other power sources on board ship—section 4472, Revised Statutes, has been amended to permit that product and other products of petroleum to be carried on vessels for gasoline (petrol) lighting and wiring systems.

The Gas Engine & Power Co. and Charles L. Seabury & Co., Consol., of Morris Heights, New York City, produce such auxiliary generating sets in 3-, 4-, 7-, 12- and



Speedway Auxiliary Generating Set

25-kilowatt capacities, operating 54, 125, 220 and 450 16-candlepower lamps respectively, or 100, 240, 425 and 850 8-candlepower lamps respectively. The 12-kilowatt set operates at 600 revolutions per minute by means of a 4-cylinder, 4-cycle gasoline (petrol) engine of 6-inch bore and 6-inch stroke, the total weight of this outfit being about 3,000 pounds. The accompanying illustration shows a 4-kilowatt set with air compressor and small bilge or fire pumps attached.

Watson Stillman Triplex Hydraulic Pump

The Watson-Stillman Company, New York, has added to its line of high-pressure hydraulic pumps a new type of motor-driven geared triplex single acting pump, which embodies some features of special merit. While primarily designed to meet the severe demands of tunnel service, it will be equally appreciated for other conditions.

To secure unusual compactness and rigidity, and also to insure perfect alinement of all the working parts when under severe service, the motor is mounted on an extension of a heavy cast iron base. The driving shaft and bearings are large and are amply provided with lubricating cups. The gears are of the heavy cut tooth type. The drive from the shaft is by eccentrics set at 120 degrees and are cast in one piece and keyed with one key to the driving shaft. The eccentric straps are heavy and the plungers are of tool steel and are guided in a rigid crosshead guide, which is keyed and bolted to the base.

The pump body is a machine steel forging with bronze valves and bonnets, and designed to eliminate and aid

Motor-Driven Hydraulic Pump

spaces. The passageways are made large to reduce friction of the water to a minimum. The pump as shown is operated by a 10 horsepower motor running at 600 revolutions per minute and delivers 100 cubic inches per minute at 3,500 pounds pressure, with a speed of the crankshaft of 100 revolutions per minute. Other sizes are built to suit operating conditions.

Proper Eye Protectors

In a large shop in New York State all the chippers are provided with eye protectors. Only a short time ago one of these workmen was struck in the eye by a very heavy chip of metal, which drove the glass back through the frame of the protection glasses he was wearing. His eye was so seriously injured by this glass that it had to be removed. These glasses offered no protection from the broken glass. The case was settled for over $4,000 (£820).

On the other hand, one of the largest steel works in this country provides the men with safety glasses which have a safety flange extending over the back of the glass. This flange prevents glass going through and injuring the eye. Recently one of their workmen was struck by a swinging crane hook. The terrific force of the blow smashed the glasses and stunned the man, but not an atom of glass entered his eye.

This shows that the danger is not so much, as many believe, from small pieces of glass as from all the glass being driven through the frame and cutting through the eyelid and eyeball. The safety flange above referred to has been approved and adopted by many of the largest industrial companies in the world.

National Officers of the M. E. B. A.

At the fortieth annual convention of the National Marine Engineers' Beneficial Association, held at the Raleigh Hotel, Washington, D. C., January 18 to 23, the following officers were elected for the ensuing year:

President, A. Bruce Gibson, 17 State street, New York.

First vice-president, E. M. Roberts, E. Main street, Stratford, Conn.

Second vice-president, C. M. Vosburgh, 6323 Patton street, New Orleans, La.

Third vice-president, Wm. C. Wilson, 6029 Lansdown avenue, Philadelphia, Pa.

Secretary, Geo. A. Grubb, 1040 Dakin street, Chicago, Ill.

Treasurer, A. L. Jones, 38 Avery avenue, Detroit, Mich.

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Personal

Peter Deitz, chief engineer of the tug *Yosephie,* is at the Gordoner ice plant at Schodack Landing, N. Y.

William F. Brookes has succeeded William Blunk as chief engineer of the river steamer *America,* at New Orleans, La.

Charles B. Hulsapple, chief engineer of the large towing steamer *Osceola,* was stricken with a serious illness at the Paterson ice plant at Van Wie's Point, New York, January 15.

William Hurst has been appointed assistant engineer on the steamer *Slack Barrett,* of the Barrett Towboat Company, Cincinnati, Ohio.

James Featherly, first assistant engineer of the Hudson River steamer *Ed. F. Murray,* is at the American ice plant, Poolsburgh, N. Y.

Joseph J. Blunk has been appointed chief engineer of the floating plants of the New Orleans Electro-Welding Company, New Orleans, La.

John E. Burlingham, chief engineer of the fast Hudson River freight steamer *Ed. F. Murray,* is employed at the McCabe ice plant at New Baltimore, N. Y.

Ambrose Van Wie, first assistant engineer of the Great Lakes tug *William H. Kinch,* is at the Venezuela ice plant of the American Ice Company at Stuyvesant, N. Y.

Naval Constructor William McEntee has succeeded Naval Constructor D. W. Taylor in charge of the experimental towing basin at the Washington Navy Yard.

A. Caulson, F. Cutchia and Joseph Cody have been appointed first, second and third assistant engineers, respectively, on the American steamer *Montana,* at New Orleans, La.

J. H. Reynolds has been appointed chief engineer of Captain W. L. Berry's new steamer *White Spot,* which recently left Paducah, Ky., on her maiden trip up the Tennessee River.

Patrick J. Killion, chief engineer of the United States Government tug *Colonel Thayer,* will be engaged in government service on the Harlem River, New York city, during the winter.

William C. Claflin, chief engineer of the tug *Florence W.,* of the Randerson Dredging Company, has accepted a position for the winter months at the Barnett Wool Shoddy Mill at Renssalaer, N. Y.

Frank Good has been appointed chief engineer of the river steamer *Barrett,* of the Barrett Towboat Company, Cincinnati, Ohio, now under charter to the West Kentucky Coal Company for towing coal to the southern ports.

Rear Admiral Frank E. Beatty, who has been in command of the third division of the Atlantic Fleet, and was formerly commandant at the Washington Navy Yard, assumed the duties of commandant at the Norfolk Navy Yard on January 4.

Sir Raymond Beck has been elected chairman of Lloyd's for the year 1915, succeeding Sir John Luscombe. Sir Raymond Beck was chairman in 1910 and 1911 and he served on the committee which prepared the State scheme of insurance of British shipping in time of war.

John B. Van Alen has been appointed chief engineer of the steel tug *Clinton,* of the Miller & Fields Dredging Company. This company has a five-year contract at Philadelphia, Pa., and the dredging outfit will leave Albany, N. Y., at the opening of navigation on the Hudson River.

Captain John Bernhard Arntzen, 63 years old, owner and master of the ferry steamer *City of Cairo,* died recently at Paducah, Ky., after a long illness. Captain Arntzen was formerly engaged in the ferry business at Cairo, Ill., and had a wide acquaintance among the western river boatmen.

Roy L. Peck, master mechanic of the Great Lakes Dredge & Dock Company, Chicago, Ill., recently made his semi-annual visit to the company's plant in the lumber district at Albany, N. Y. Mr. Peck was formerly a government steamboat inspector at Chicago, and a chief engineer of steamers on the Great Lakes.

Edward L. Latham, chief engineer of the river steamer *St. Louis,* is superintending the erection of the machinery for a new boat for the St. Louis & Tennessee River Packet Company, which will operate from Riverton to Florence, Ala. Mr. Latham will be engineer of the new steamer until the *St. Louis* starts out again in the St. Louis and Tennessee River trade.

James E. McCormick, a retired marine engineer, died in New York city December 30 at the age of seventy-six. Mr. McCormick was born in Albany, N. Y., and was originally on the Hudson River steamer *Old Belle,* of the Cornell Steamboat Company. Later he was with the Morgan Line, and before his retirement from active service he was for fifteen years employed on the steamers of the Iron Steamboat Company, New York.

Naval Constructor R. M. Watt, formerly chief of the Bureau of Construction and Repair of the Navy, assumed the duties of industrial manager at the Norfolk Navy Yard on January 11. The other officers assigned to the Norfolk Navy Yard are Naval Constructor W. G. Du Bose, construction superintendent; Naval Constructor George S. Radford, shop superintendent, and Lieutenant Commander Henry E. Lackey, engineer superintendent.

Samuel Hutton, chief engineer of the steamer *Betty,* working on the United States Government dam at Troy, N. Y., had a narrow escape recently when the *Betty* foundered in 30 feet of water. Mr. Hutton was rescued by the government employees. One other vessel, the United States Government steamer *Gen. Totten,* was also sunk in the river at this dam. These boats were engaged in breaking the ice which was forming around the new work and it will now be impossible to continue the work until spring.

Ezra Nicholson, inventor of the Nicholson recording ship log, died recently at his home in Lakewood, Ohio, aged eighty. Mr. Nicholson was educated in the public schools, at Berea College and later at Urbana University. In his early life he was engaged in horticulture. He saw active service in the Civil War and at the close of the war he became president of the Rocky River Railroad, a steam suburban road running from Cleveland to Rocky River. Mr. Nicholson later established part of the Nickel Plate Railroad. With the incorporation of the city of Lakewood (Ohio), Mr. Nicholson became its first clerk and treasurer and was prominently identified with the growth of the city.

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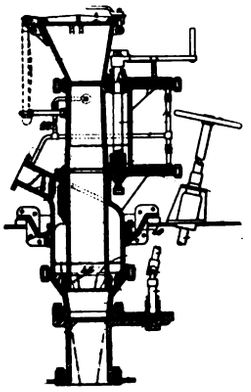
SELECTED MARINE PATENTS

The publication in this column of a patent specification does not necessarily imply editorial commendation.

American patents compiled by Delbert H. Decker, Esq., registered patent attorney, Millerton, N. Y.

1,112,151. UNDER-WATER ASH-EJECTOR. JOHN F. METTEN, OF PHILADELPHIA, PA.

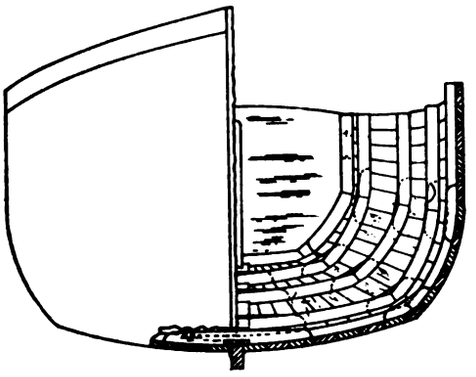
Claim 1.—In an ash-ejector adapted to discharge below water level, the combination of a tube opening through the ship below the water level, a casing connected with said tube and containing movable gates



adapted to open and close said tube, seats for said gates comprised between sections of said tube, said gates being spaced from said seats, and means for discharging water over said seats into said tube. Fourteen claims.

1,116,724. HULL FOR MARINE CRAFT. FRANK NICHOLAS, OF MONROE, NEW YORK.

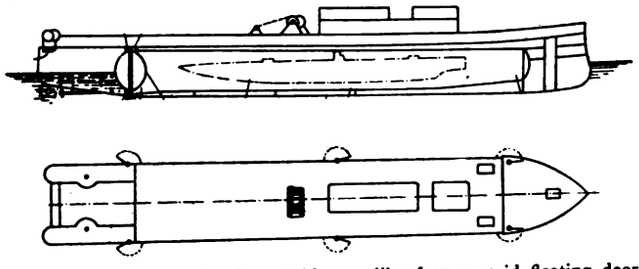
Claim 6.—In a hull for marine surface craft having hull-sections set at an angle to each other, the combination with the keel and deck-plates



thereof, of a series of chine-pieces arranged between said keel and deck-plates substantially parallel therewith, and circular-arc ribs extending transversely between said series of chine-pieces and the keel, between said series of chine-pieces and in the deck plates, and also between the various individual chine-pieces of said series. Six claims.

1,113,450. SUBMARINE TENDER. CESARE LAURENTI, OF SPEZIA, ITALY, ASSIGNOR TO SOCIETA FIAT-SAN GIORGIO, OF SPEZIA, ITALY.

Claim 1.—A tender or lighter comprising an inner shell adapted to be closed watertight by a floating door at one end thereof is in the form of a single hull and for another portion of its length projects beyond the aforesaid open end of the inner shell in the form of twin



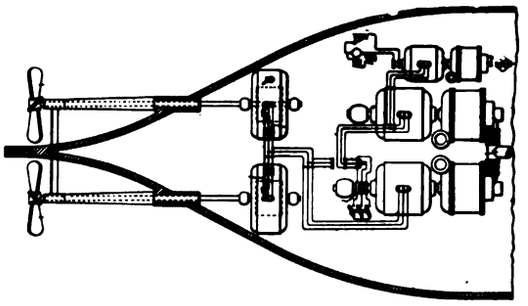
hulls connected together by a bridge or like frames, said floating door being lenticular in shape and adapted to be floated into position and provided with lugs or the like, said shell being provided with recesses provided therefor at the open end thereof through which said lugs on the door are adapted to pass when the door is in its longitudinal and slanting position, which recesses will be covered by said door when the door is in the upright transverse position so that in the last-named position the door will close the inner shell watertight either from without or from within as required. Seven claims.

1,111,139. TORPEDO-PILOT BOAT FOR AUTOMOBILE TORPEDOES. SLOAN DANENHOWER, OF BRIDGEPORT, CONN.

Claim 12.—The combination with a submersible torpedo-pilot boat having two pontoons furnished with fin-keels and provided with a single central control-compartment, of an automobile torpedo detachably supported by and between said keels, and independent means operable from said compartment for starting the propelling mechanism of the torpedo and for releasing it whereby it may travel independently of the boat. Thirteen claims.

1,118,382. PROPELLING SHIPS BY POLYPHASE ELECTRIC CURRENT. ELIHU THOMSON, OF SWAMPSCOTT, MASS., ASSIGNOR TO GENERAL ELECTRIC COMPANY, A CORPORATION OF NEW YORK.

Claim 1.—In a system the combination of polyphase generators of the induction type, said generators having stationary armatures and ro-



tating fields that are mounted on separate shafts, an auxiliary synchronous generator for fixing the frequencies of the poyphase generators, means for varying the speed of the auxiliary generator, electrical connecting means for connecting the main generators to operate as induction generators in parallel under certain conditions, and means for connecting the main generators in concatenation so that one generator operates as an excited field generator for other conditions of operation. Three claims.

British patents compiled by G. F. Redfern & Company, chartered patent agents and engineers, 15 South street, Finsbury, E. C., and 10 Gray's Inn Place, W. C., London.

10,734/1914. ANTI-FRICTION BEARING FOR THE JOURNALS OF COMPASS BOWLS. W. D. WHYTE, 96 HOPE STREET, GLASGOW.

Claim—The object of the invention is to obviate the use of rollers which have heretofore been employed. The improved bearing comprises two or more balls held in position in a semi-circular cage, formed in two parts connected together by cross pins, the balls being so set in countersunk holes in the parts as to be free to revolve. The balls are of a diameter greater than the width of the cage. The cage itself is set, as usual, in a recess in the gymbal ring or in the binnacle flange, as the case may be.

24,971/1913. IMPROVEMENTS IN DAVITS FOR SHIPS BOATS. J. R. BARNETT WESTERFIELD, RALSTON AVENUE, ROOKSTON, RENFREWSHIRE, SCOTLAND.

Claim.—Consists of a pair of davits curved to an inboard direction to suspend the ships boat and hinged to the deck of the ship, thus putting the boat inboard and outboard and operated mechanically by a handle and screw gear connected with a double span to the pair of davits.

25,085/1913. IMPROVEMENTS IN TELESCOPIC MASTS. T. D. SMITH, BAROON FALLS VIA NAMBOUR, QUEENSLAND, AUSTRALIA.

Claim.—A telescopic mast having a sheath and telescope sections adapted to collapse within same, characterized by a casting to enclose a gag rope around the mast sheath, and gearing adapted to rotate the reel and simultaneously raise the mast sections.

6,028/1914. IMPROVEMENTS IN RUDDER PINTLES. J. M. RAMSAY, ELBERRY IRVINE ROAD, KILMARNOCK, AYRSHIRE.

Claim.—Consists in the arrangement of the nut fastening, the pintle being placed upon the upper side of the sternpost gudgeon, and the pintle being so shaped that it can be withdrawn downwards; the position of the rudder gudgeon being above the fastening nut.

7954/1914. IMPROVED COMPOSITION PRINCIPALLY INTENDED FOR COATING SHIPS' DECKS AND LIKE FLOORING PURPOSES. SIR. A. DENNY, OF THE FIRM OF W. DENNY & BROS. OF LEVEN SHIP YARD, DUMBARTON, AND D. G. ANDERSON, 10 WENDOVER CRESCENT, MOUNT FLORIDA, GLASGOW.

Claim.—In forming the improved composition, all the solid ingredients used are first intimately mixed together, and sufficient water added to form a stiff granular paste which is spread on the surface to be covered, then stamped down and surfaced by trowelling all in the usual manner. With the water there may be added a dilute solution of sodium aluminate. As indicative but not limitative the following example is given in parts by weight. Gypsum cement, 100 parts; Portland cement, 15 parts; pumice, 20 parts, and sawdust 20 parts.

11,503/1913. "IMPROVEMENTS IN MARINERS' COMPASSES." KELVIN & JAMES WHITE, LTD., AND OTHERS, GLASGOW.

A mariner's compass having an optical system including magnifying and reflecting means supported independently of the compass bowl and capable of use when the binnacle hood is in place, said magnifying means being constituted by a lens or lenses used as a reading glass, or other means optically equivalent thereto, said optical system being adapted to present to the observer a vertically, or approximately vertically, disposed magnified image of a substantial segment of the card, along with an image of the lubber mark, without the intervention of a screen and without reversal of the markings on the card.

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